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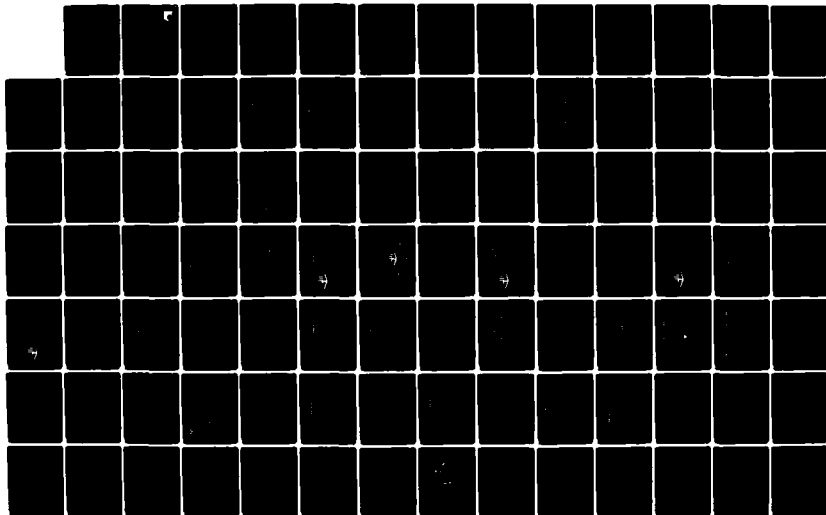
INTEGRATED COMPUTER-AIDED MANUFACTURING (ICAM)  
ARCHITECTURE PART 3 VOLUME..(U) SOFTECH INC WALTHAM MA  
A W SNODGRASS SEP 83 1080-37  
AFWAL-TR-82-4063-PT-3-VOL-8

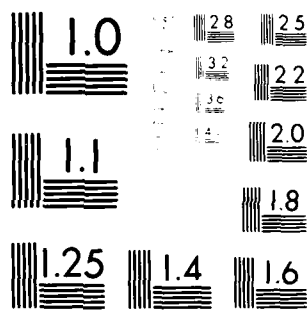
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INTEGRATED COMPUTER-AIDED MANUFACTURING (ICAM)  
ARCHITECTURE PART III  
VOLUME VIII - TECHNOLOGY TRANSFER

SoftTech, Inc.  
450 Totten Pond Road  
Waltham, MA 02154

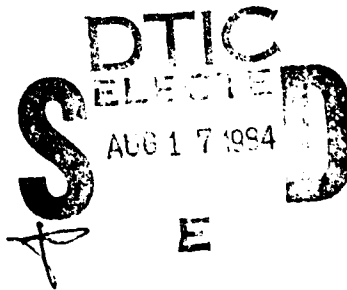
September 1983

Final Report for September 1980 - October 1982

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MATERIALS LABORATORY  
AIR FORCE WRIGHT AERONAUTICAL LABORATORIES  
AIR FORCE SYSTEMS COMMAND  
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433



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This report has been reviewed by the Office of Public Affairs (ASD/PA), and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.



RICHARD R. PRESTON, Captain, USAF  
Project Manager  
Computer Integrated Manufacturing Branch  
Manufacturing Technology Division

13 July 1984  
Approval Date

FOR THE COMMANDER



NATHAN G. TUPPER  
Chief  
Computer Integrated Manufacturing Branch  
Manufacturing Technology Division

13 July 84  
Approval Date

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21. ABSTRACT (Continue on reverse side if necessary and identify by block number) The Integrated Computer Aided Manufacturing (ICAM) Architecture Part III was initiated to maintain and update the existing manufacturing architecture as well as develop training courses to assist in the transition of IDEF applications, concepts and procedures to other Air Force programs. This volume presents the three courses designed to transfer IDEF concepts and techniques to other ICAM Programs. → S. P. H		

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This report is presented in the following eight volumes:

1. Volume I - Architecture Part III Accomplishments
2. Volume II - Procedures
3. Volume III - Composite Function Model of "Design Product" (DES0)
4. Volume IV - Composite Information Model of "Design Product" (DES1)
5. Volume V - Composite Function Model of "Manufacture Product" (MFG0)
6. Volume VI - Composite Information Model of "Manufacture Product" (MFG1)
7. Volume VII - MFG01 Glossary
8. Volume VIII - Technology Transfer

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## FOREWORD

This technical report provides the results of the Technology Transfer Task associated with the IDEF Function Modeling. This work was performed under U.S. Air Force Contract #F33615-80-C-5109, "ICAM ARCHITECTURE, PART III," covering the period of September 1980 through October 1982. The contract was sponsored by the Computer Integrated Manufacturing Branch, Materials Laboratory, Air Force Wright Aeronautical Laboratories, Air Force Systems Command, Wright Patterson Air Force Base, Ohio, 45433. The Air Force Technical Manager for ICAM ARCHITECTURE PART III was Capt Steve R. LeClair for the basic contract and Capt Richard R. Preston for the option phase.

Ms Bette R. Davis was the SofTech Program Manager. The other contributor to this document was A.W. Snodgrass, DACOM.

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## Section 1 SCOPE

### 1.1 Identification

This volume documents the material developed to facilitate the dissemination of the concepts developed under the ICAM program.

This technology transfer material provides an executive overview of ICAM and Technology Modernization (TechMod) techniques and benefits and, separately, course material for teaching the IDEF methodology. For each of these two subjects, a presentation manual and a "train the trainers" manual is provided.

The presentation manuals include guidance for: setup, pre-presentation activities, presentation, and post-presentation activities. These manuals also include hard copies of the actual slides used in the presentation. The "train the trainers" manuals repeat the material of the presentation manuals, but add an instructional objective and a suggested narration for each slide. ^

This volume documents work performed under ICAM Project Priority 1104 - ICAM Architecture of Manufacturing Part III.

### 1.2 Background

The Integrated Computer Aided Manufacturing (ICAM) program has as its objective the improvement of productivity in the aerospace manufacturing sectors of American industry. It is directed toward improving productivity through the systematic application of computer technology in the design and manufacturing environment. This approach is not only ambitious, but is also realistic in that it stresses the development of computer aided design and manufacturing capabilities. The integration of these computer aids into the design and manufacturing environment and among themselves will ultimately signal the success of the ICAM program.

A key to the achievement of this goal is the development of the ICAM Definition (IDEF) Methods and the ICAM composite models of design and manufacturing. The ICAM Definition Methods are a family of techniques through which -- analysts and laymen explore and discuss the nature of design and manufacturing systems. These techniques, developed for the ICAM program, provide a means of studying, recording, and communicating the inherent requirements and realities of the aerospace manufacturing environment. They are equally effective and valuable in many other manufacturing and non-manufacturing environments.

There are three ICAM Definition Methods: IDEF0 - Function Modeling; IDEF1 - Information Modeling; and IDEF2 - Dynamics Modeling. A manufacturing system is described and studied through the application of all three techniques.

The ICAM composite models of manufacturing, or architectures, record a "composite view" of what manufacturing is and how it operates. Composite architectures are presented in two forms: the "AS IS form -- representing the way in which design and manufacturing are currently accomplished; and the "TO BE" form -- representing the way in which design and manufacturing will be accomplished with computer aids in place.

### Architecture Process

The necessary first step in increasing the productivity of design and manufacture is to understand current design and manufacturing practice precisely and to record this understanding concisely. This development of understanding has two main phases:

- Study specific company
- Evolve a composite understanding.

### Factory View

Understanding of the current design and manufacturing process must be based on the detailed factual information which describes this process in those companies which successfully produce aerospace products. This has been called "Factory View" information. The Factory View of manufacturing and design is different for each company, for each division of a company, for each plant within a company, and even somewhat different for each organization and each individual within each plant.

### Composite View

One objective of ICAM is to develop improvements in the design and manufacturing process which will be broadly applicable across the whole aerospace industry. In order to do this, it is necessary to have some understanding of "general or generic design and manufacturing practice." Such an understanding emphasizes the essential information necessary to all design and manufacturing processes, while de-emphasizing the differences of organization and terminology among the various factory views.

As prime contractor, SofTech contracted to DACOM the development of the technology transfer packages. Successful technology transfer is central to the stated objective of improving productivity in the aerospace manufacturing sectors of American industry. This transfer must encompass an understanding at the executive level as well as at the

practitioners level. These levels are addressed by the packages documented here.

### 1.3 Functional Description of Document

This volume documents the technology transfer materials developed under ICAM Project Priority 1104 - ICAM Architecture of Manufacturing Part III. The remaining sections of this book are also available as individual publications follows:

- |             |  |
|-------------|--|
| Section 2.1 | TM 110460001U<br>Technology Transfer Executive<br>Overview Presentation Manual<br>May, 1982          |
| Section 2.2 | TM 110460002U<br>Technology Transfer Executive<br>Overview "Train the Trainers"<br>Manual, May, 1982 |
| Section 2.3 | TM 110460003U<br>Technology Transfer Practitioner's<br>Presentation Manual,<br>May, 1982             |
| Section 2.4 | TM 110460004U<br>Technology Transfer Practitioner's<br>"Train the Trainers" Manual,<br>May, 1982     |

Also available, and included as an appendix to this volume, is a Technology Transfer Program Task Report Summary, which provides a detailed chronology of this development effort.

Use the following Request Order Form to request copies of Technology Transfer Documents, and submit to:

ICAM Program Library  
AFWAL/MLTC  
Wright-Patterson AFB, OH 45433

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8 September 1983

ARCHITECTURE PART II - FINAL REPORT

DOCUMENT REQUEST ORDER FORM

VOLUME I - Architecture Part III Accomplishments  
VOLUME II - Procedures  
VOLUME III - Composite Function Model of "Design Product" (DES0)  
VOLUME IV - Composite Information Model of "Design Product" (DES1)  
VOLUME V - Composite Function Model of "Manufacture Product" (MFG0)  
VOLUME VI - Composite Information Model of "Manufacture Product" (MFG1)  
VOLUME VII - MFG01 Glossary  
VOLUME VIII - Technology Transfer

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Submit document requests to: ICAM Program Library  
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Section 2  
TECHNOLOGY TRANSFER MANUALS

2.1 Technology Transfer Executive Overview Presentation Manual

FORWORD

This instructor's Presentation Manual is designed to help orient and educate executive level management relative to the need for a structured approach to implementing new manufacturing technology, thereby gaining productivity. It provides an overview of the U.S. Air Force's Manufacturing Technology Modernization (TECHMOD) Program's use of related IDEF applications, concepts, and procedures. It also covers the use of ICAM Architecture in planning and controlling these Manufacturing Technology Modernization Programs to upgrade the U.S. industrial base.

This Presentation Manual, coupled with the accompanying "Train the Trainers" Manual, is designed to give the instructor maximum efficiency in orienting executive level personnel. It employs a step-by-step and section-by-section process, dealing with "top-down" Manufacturing Technology Modernization planning and "bottom-up" project implementation.

2.1.1 Introduction

This is an instructor's Presentation Manual intended to aid those teaching an executive overview of the Air Force Manufacturing Technology Modernization (TECH MOD) Program's use of ICAM IDEF Modeling Methodologies.

This Instructor's Presentation Manual consists of a guide for conducting an Executive Level briefing. The instructor's Executive Overview "Train the Trainers" Manual provides a step-by-step text, containing the objectives and procedures to be covered, concepts, and a suggested narration (with which to start).

The course materials are presented in a standardized format. Each page is composed of a copy of the presentation material, the instructional objective that must be covered with that material, and a suggested narration that may be followed until individual styles can be developed.

Overall planning for and conducting of actual executive training sessions is almost as critical to accomplishing participant learning objectives as the course presentation material. Attention must be given

to planning for presentation set-up, pre-presentation, presentation, and post-presentation activities.

#### 2.1.1.1 Presentation Set-Up

##### 2.1.1.1.1 Audio/Visual Equipment:

- a) Overhead vue foil projector
- b) 35mm projector (if slides are used)

##### 2.1.1.1.2 Audio/Visual Aids:

- a) Overhead transparencies
- b) 35mm color transparencies (when slides are used)
- c) Training materials (handouts and/or manuals)

##### 2.1.1.1.3 Room Set-up:

Everyone must be in hearing and seeing distance of the presentation.

REMEMBER: The best instructional program is no good if you can't hear and see it!

#### 2.1.1.2 Pre-Presentation

- Review all training materials beforehand and be familiar with them.
- Make sure room, equipment, and materials are all in order and ready to go when you are.  
  
REMEMBER: Prior planning prevents poor performance!
- Set up audio/visual equipment.
- Get audio/visual aids ready for presentation.
  - a) Make sure all overhead transparencies are in their order of presentation.
  - b) Make sure all 35mm color transparencies (when slides are used) are in their order of presentation and that they are all placed in carousel right-reading, (a slide in backwards or upside down can throw your whole presentation off kilter).

- Handout copies of presentation materials may be provided if warranted by advance coordination.

#### 2.1.1.3 Presentation

- Give introduction
  - a) Include purpose and viewpoint of presentation.
  - b) Set atmosphere conducive to learning.
- Go through training materials step-by-step.
- Use peer cross-referencing method to check for understanding.

##### PEER CROSS-REFERENCING METHOD

- a) Ask who understands the point you've just presented.
- b) Ask who isn't clear about it.
- c) Ask if anyone who understands the point can explain it to those who don't.

NOTE: If you don't get any takers, you must explain it over again, if possible, in different terms.

- REMEMBER:

Just because you've presented the material doesn't mean that everyone has understood it.

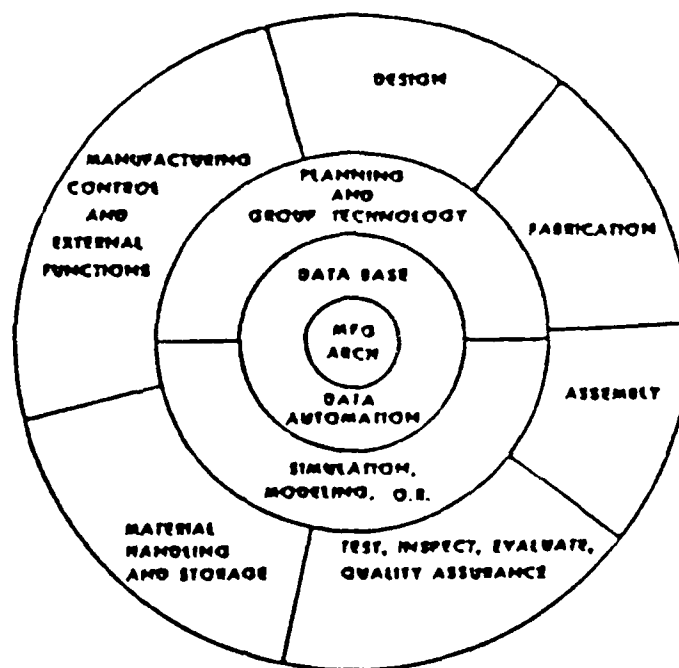
#### 2.1.1.4 Post Presentation

- Try not to leave any question unanswered. If you don't know, find out, and write or call with the answer.
- At some time, a sheet could be filled out with the name, organization, department, phone number, etc. of those attending. Get sheet typed and make copies to give to everyone. Use for:
  - historical record
  - contact sheet.

#### 2.1.2 A Structured Approach to Manufacturing Technology and Productivity

# USAF MANUFACTURING TECHNOLOGY PROGRAM

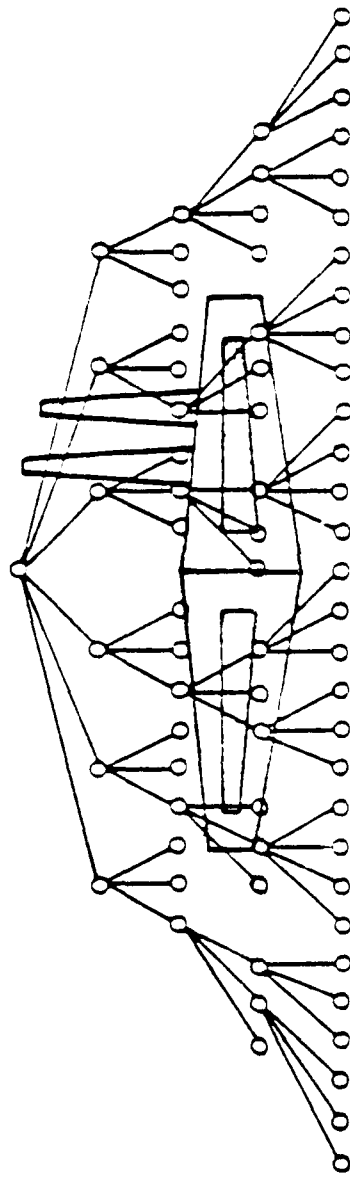
A MANUFACTURING TECHNOLOGY MODERNIZATION  
PROGRAM CONCEPT FOR  
INTEGRATED COMPUTER-AIDED MANUFACTURING (ICAM)  
IDEF/ARCHITECTURE METHODOLOGY



EXECUTIVE OVERVIEW PRESENTATION MANUAL

# EXECUTIVE OVERVIEW

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# A STRUCTURED APPROACH TO MANUFACTURING TECHNOLOGY AND PRODUCTIVITY

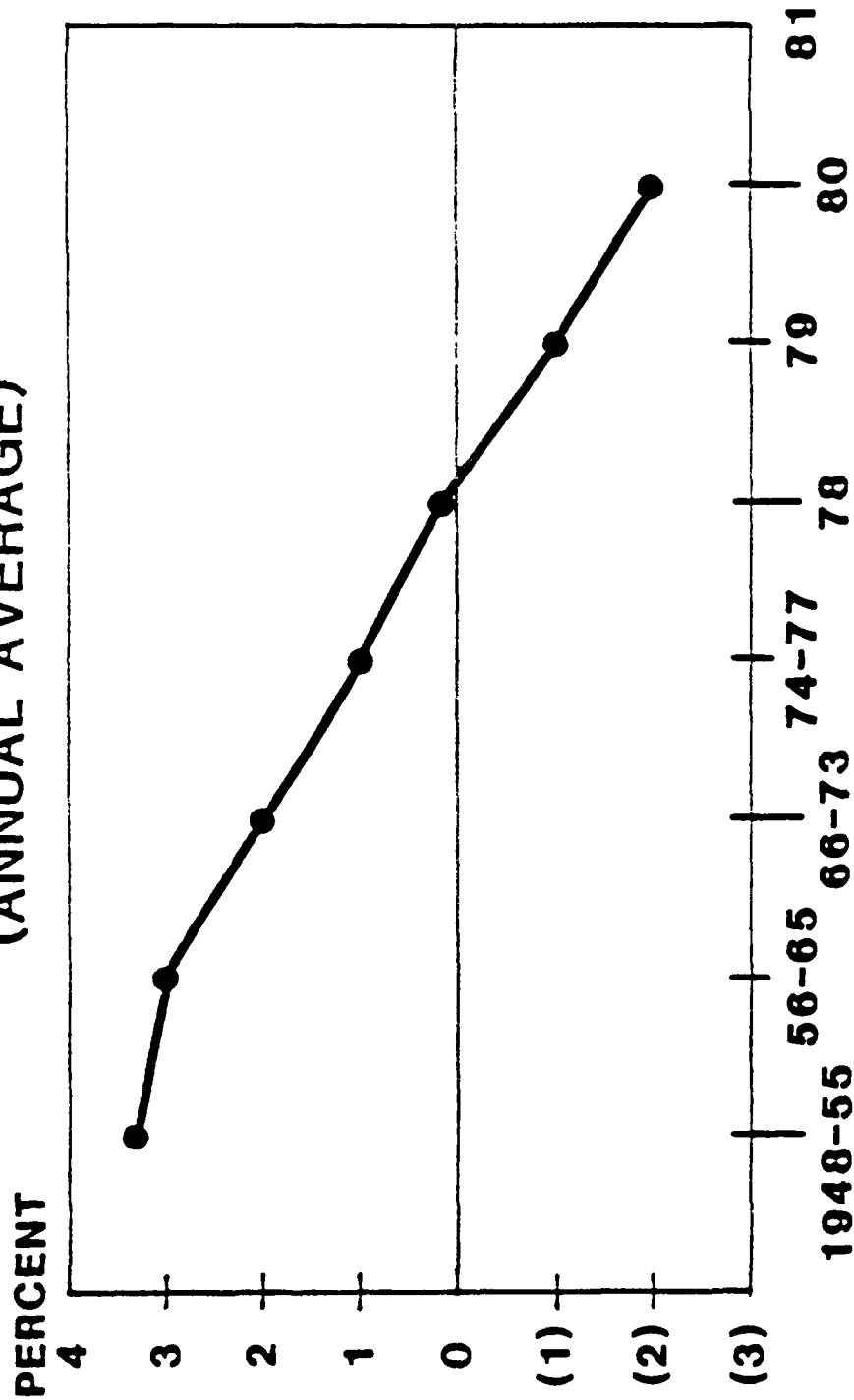
# **INTRODUCTION**

---

- THE PROBLEM
  - U.S. PRODUCTIVITY PERFORMANCE
  - U.S. INDUSTRY AUTOMATION TECHNOLOGY
- THE SOLUTION
  - INTEGRATED COMPUTER AIDED  
MANUFACTURING/TECH MODS
  - ICAM ANALYTICAL/PLANNING TOOLS
  - INTEGRATED STRATEGIC PLANNING &  
INFORMATION RESOURCE  
MANAGEMENT (IRM)

# THE PROBLEM

PRODUCTIVITY GROWTH RATE IN U.S.  
(ANNUAL AVERAGE)



SOURCE U.S. DEPARTMENT OF COMMERCE

# **EXTERNAL ENVIRONMENT "CAUSES"**

- SOCIAL TRENDS
- HIGH INFLATION RATE
- GOVERNMENT REGULATIONS
- R&D LOW PRIORITY
- LACK OF CAPITAL IMPROVEMENT  
INCENTIVES

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8 September 1983



## **DECLINING PRODUCTIVITY "SYMPTOMS"**

- OVERHEAD AND INDIRECT RESPONSIBLE FOR  
60-70% OF PRODUCT COST
- AVERAGE MACHINE UTILIZATION LESS THAN 30%
- DIRECT FAB PROCESS ONLY 1 1/2% PART'S  
"SHOP LIFE"
- RISING LABOR COSTS BEING DIRECTLY PASSED  
ON TO CONSUMERS
- INCREASING SOCIAL PRESSURES

# **LOST PRODUCTIVITY**

**"AMERICAN WORKERS ACTUALLY ARE  
PRODUCING, ON AVERAGE, ONLY ABOUT 55%  
OF THE TIME THEY ARE ON THE JOB. THE  
RESULTING LOSS TOTALS 350 BILLION  
DOLLARS ANNUALLY."**

**T. BARRY & ASSOCIATES**

**INDUSTRIAL ENGRG-NOV.'80**

**45%**

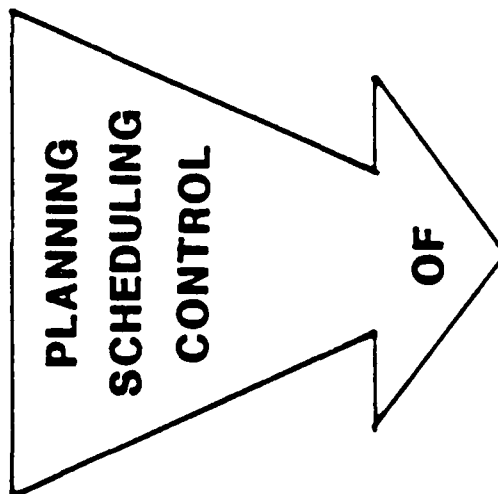
# **OF DIRECT LABOR TIME IS NOT PRODUCTIVE**

---

## **SOURCE**

- **35% POOR SCHEDULING**
- **25% POOR INSTRUCTIONS**
- **15% INFLEXIBILITY**
- **25% POOR MATERIAL FLOW**

## **PAYOFF**



**PEOPLE  
MATERIALS  
FACILITIES**

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# **U.S. INDUSTRY AUTOMATION TECHNOLOGY**

## U.S. INDUSTRY AUTOMATION TECHNOLOGY

---

- AUTOMATION INVESTMENTS WILL TRIPLE TO \$5+BILLION BY 1985.
- CAD SYSTEMS WILL CLIMB +35% ANNUALLY TO ESTIMATED \$2.5 BILLION IN 1985 FROM \$610 MILLION IN 1979.
- MINICOMPUTERS, NUMERICAL CONTROLS AND PROGRAMMABLE CONTROLLERS WILL CLIMB +35% ANNUALLY TO \$2.3 BILLION IN 1985 FROM \$570 MILLION IN 1980.
- ROBOTS WILL JUMP TO 80,000 UNITS BY 1985 FROM 2,000 UNITS IN 1981 TO TOTAL OF \$+600 MILLION.

BUSINESS WEEK - 3 AUG 1981 "THE SPEED UP IN AUTOMATION"

## EXECUTIVE MANAGEMENT TAKING "TOP DOWN" ACTION

---

- OFFICE AUTOMATION - 38 MILLION OF 50 MILLION WHITE COLLAR JOBS AFFECTED ( WITH 20 TO 30 MILLION BY 1990 ) AT 20% VALUE ADDED PER EMPLOYEE.
- FLEXIBLE MANUFACTURING SYSTEM ( FMS ) - USERS EXPERIENCING IMPROVED MACHINE TOOL UTILIZATION AS MUCH AS 45% AND DECREASING WORKERS BY 30%
- CAD / CAM SYSTEMS - TO CUT MANUFACTURING LEADTIME BY 25% AND INCREASE PRODUCTIVITY AS MUCH AS FOURFOLD
- TOP EXECUTIVES - NOW FORCING SOLUTIONS IN ORDER TO REMAIN IN BUSINESS IN THE 1990's.
- DECISIONS - TO AUTOMATE ARE STARTING AT THE BOARD LEVEL AND MOVING DOWN.

BUSINESS WEEK - 3 AUG 1981 "THE SPEED UP IN AUTOMATION"

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# THE LEMMING APPROACH TO AUTOMATION



# TECHNOLOGY INTEGRATION

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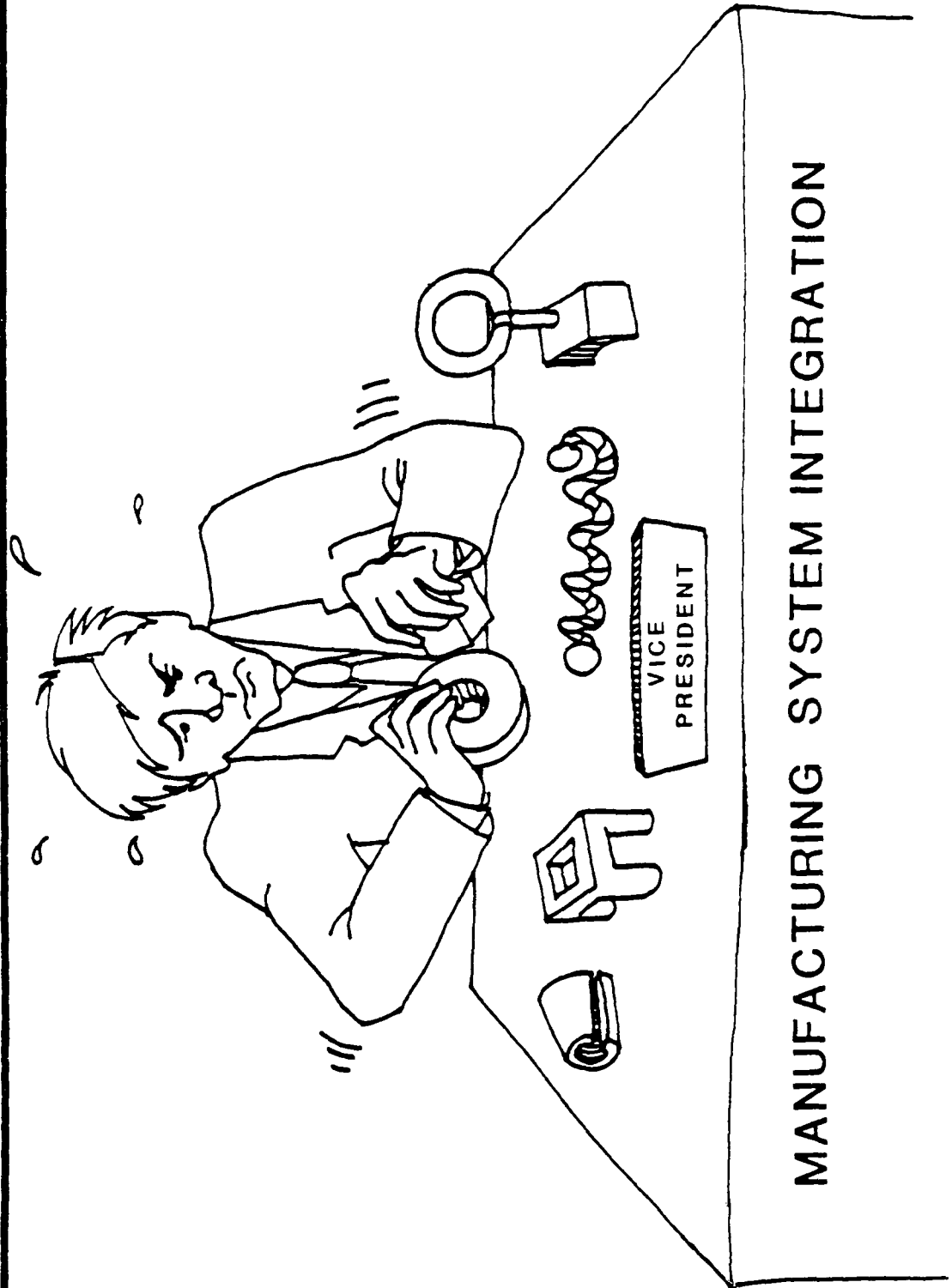
- AN AVALANCHE OF UNCOORDINATED  
AUTOMATION TECHNOLOGY MODERNIZATION  
PROJECTS THREATENS TO BURY U.S. INDUSTRY

## UNLESS THERE IS

- TECHNOLOGY INTEGRATION
- SOMETIMES REFERRED TO AS
- COMPUTER INTEGRATED MANUFACTURING ( CIM )



# C O M P U T E R I N T E G R A T E D M A N U F A C T U R I N G



## COMPUTER INTEGRATED MANUFACTURING

- MANUFACTURING, WHICH BEGINS WITH PRODUCT DESIGN AND ENDS WITH SUPPORT AND MAINTENANCE IN THE FIELD, IS A MONOLITHIC, INDIVISIBLE FUNCTION. --- NO PART CAN BE SUCCESSFULLY CONSIDERED IN ISOLATION FROM ALL

### OTHER PARTS.

- DIVERSE AS THE VARIOUS PARTS OF MANUFACTURING MAY SEEM, THERE IS A COMMON THREAD THAT RUNS THROUGH THE FULL SCOPE OF ALL MANUFACTURING ACTIVITIES. --- MANUFACTURING IS, IN THE ULTIMATE ANALYSIS, A SERIES OF DATA PROCESSING OPERATIONS.

DR. JOSEPH HARRINGTON  
1980 CAD/CAM CONFERENCE

## SIGNIFICANT IMPACTS ON U.S. HUMAN RESOURCES

---

- SHORT PRODUCTION RUNS NOW ACCOUNT FOR 75% U.S. MANUFACTURING
- CAD/CAM AFFORDABLE FOR SMALL JOB SHOPS WITHIN DECADE
- CHANGES WILL AFFECT 45 MILLION JOBS IN U.S. NEXT 20 YEARS
- ONLY 13,000 CANDIDATES AVAILABLE IN 1981 TO FILL 29,000 ELECTRICAL AND COMPUTER SOFTWARE ENGINEERING SLOTS ( BY 1985 SUPPLY WILL BE 15,000 VS. 51,000 DEMAND )

BUSINESS WEEK 3 AUG 1981 "THE SPEED UP IN AUTOMATION"

## U.S. INDUSTRY AUTOMATION TECHNOLOGY

---

- NO OTHER COUNTRY MATCHES U.S. IN COMPUTER SOFTWARE AND COMPUTER AIDED DESIGN.
- 90% OF JAPAN'S CAD SYSTEMS IMPORTED FROM U.S. - \$100 MILLION IN 1980 AND RISING.
- COMPUTER POWER COST DECREASING AVERAGE 50% EVERY 2 1/2 YEARS SINCE 1970.
- SOFTWARE DEVELOPMENT NOW PACING FACTORY AUTOMATION:

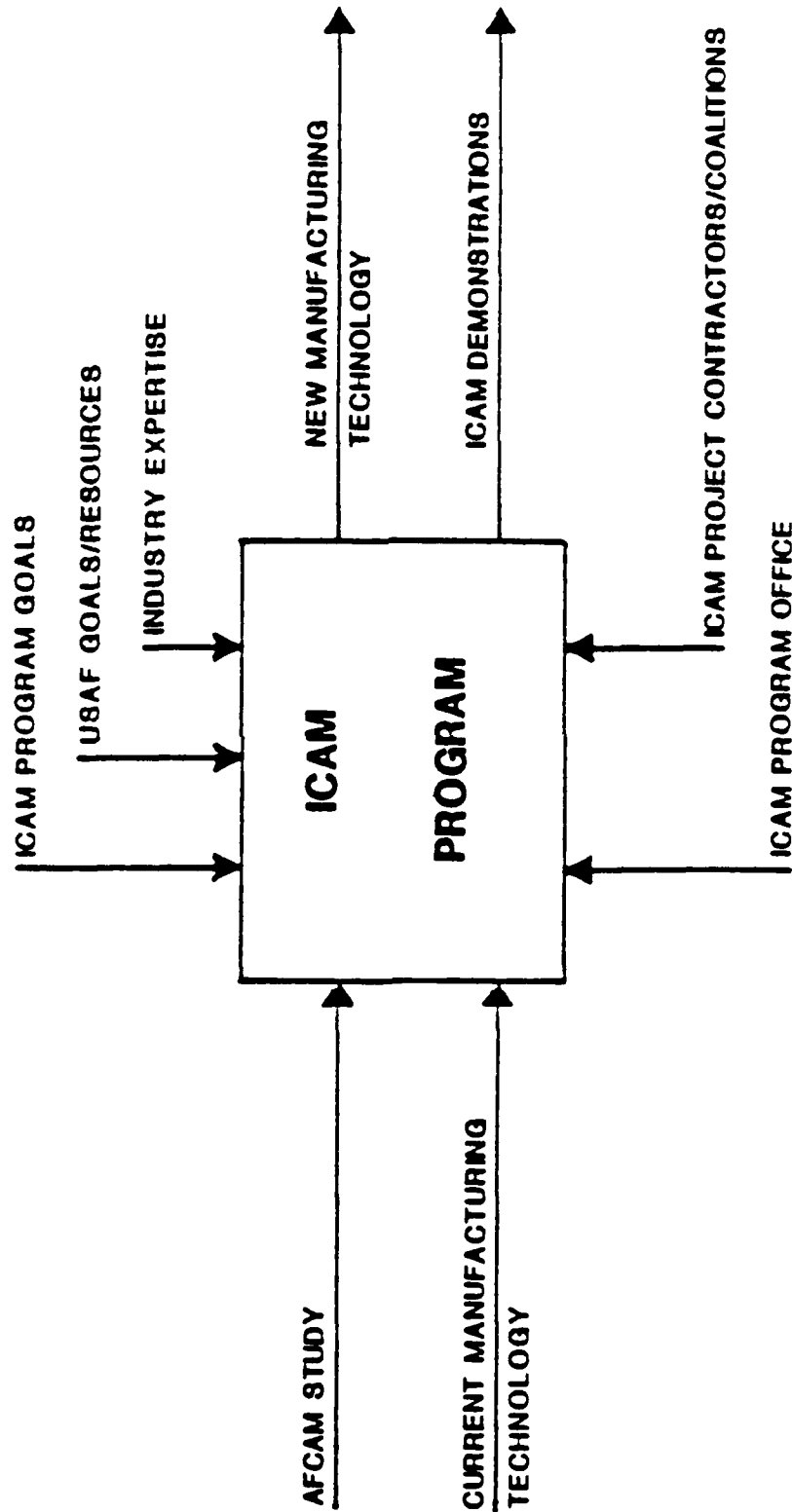
- STANDARD GEOMETRIC SHAPE DEFINITION
- INTEGRATED DATA BASES
- COMMUNICATION PROTOCOLS
- INFORMATION RESOURCE MANAGEMENT

BUSINESS WEEK - 3 AUG 1981 "THE SPEED UP IN AUTOMATION"

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**INTEGRATED  
COMPUTER AIDED MANUFACTURING  
(ICAM)  
PROGRAM**

# ICAM PROGRAM

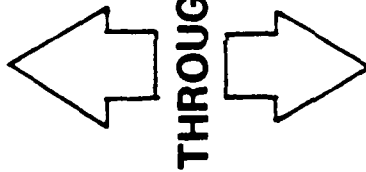


## **ICAM PROGRAM OBJECTIVES**

- REDUCE DEFENSE SYSTEM COSTS THROUGH CAM TECHNOLOGY
- ESTABLISH MEANS FOR INTEGRATED APPLICATION OF  
COMPUTER TECHNOLOGY
- IMPROVE LONG TERM COMPETENCE, EFFICIENCY AND  
RESPONSIVENESS TO DEFENSE NEEDS
- PROVIDE MECHANISM FOR ICAM TECHNOLOGY TRANSFER
- VALIDATE AND DEMONSTRATE COST SAVINGS & FLEXIBILITY  
OF ICAM METHODOLOGY

# ICAM PROGRAM OBJECTIVES

PRODUCTIVITY IMPROVEMENTS



THROUGH

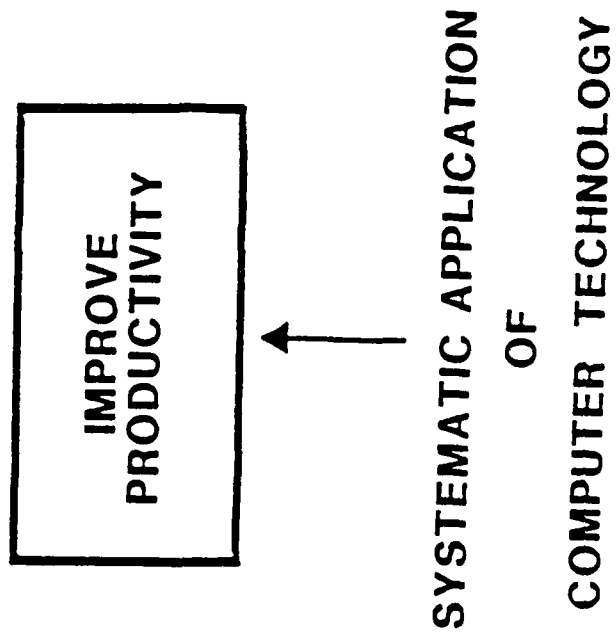
COMPUTER TECHNOLOGY

AND

FACTORY MODERNIZATION

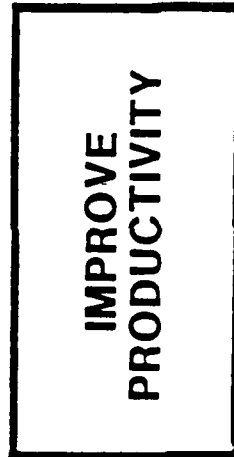


# PURPOSE OF ICAM



# ICAM APPROACH

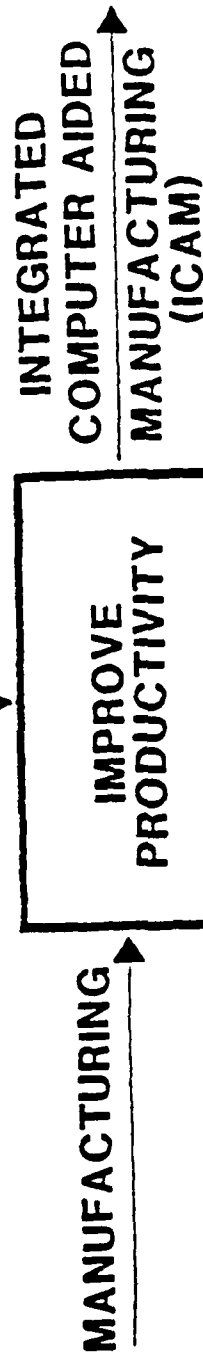
COMMUNICATION AND ANALYSIS



SYSTEMATIC APPLICATION  
OF  
COMPUTER TECHNOLOGY

# OBJECTIVE OF ICAM

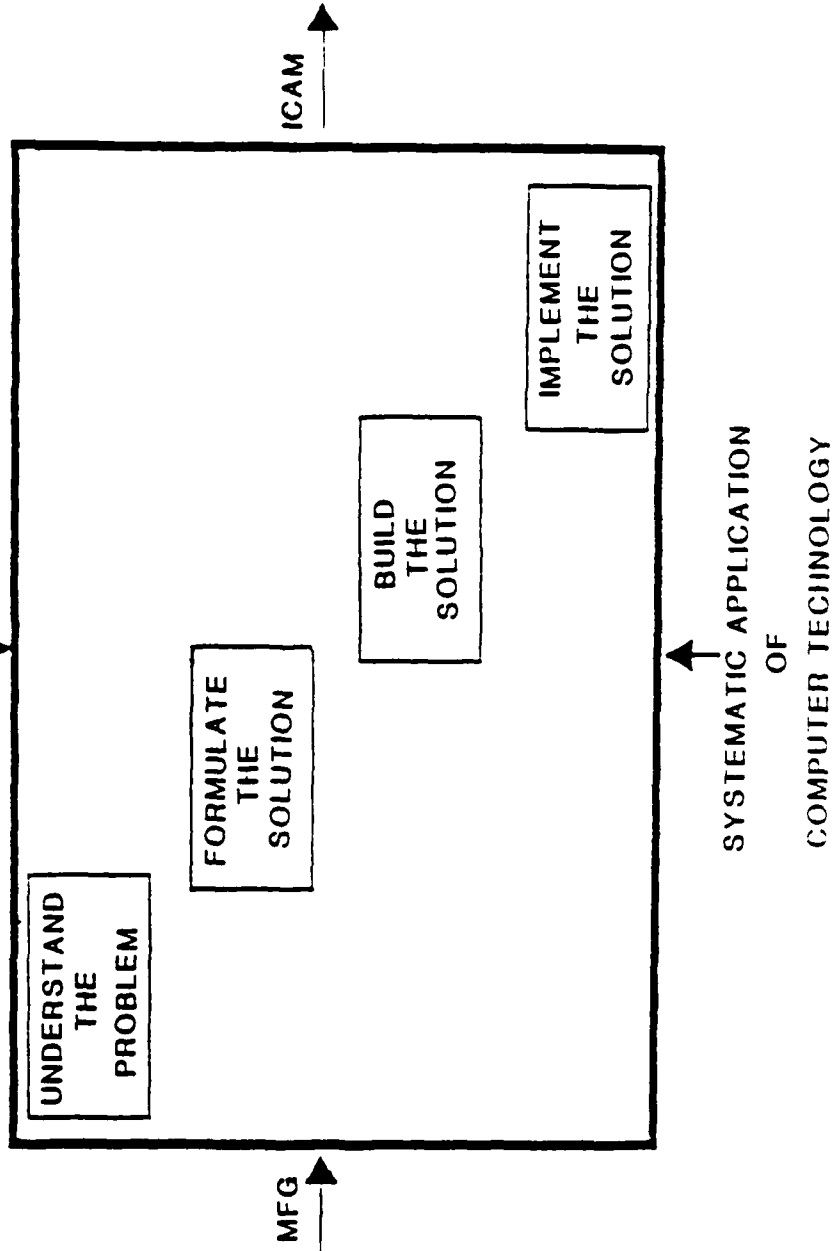
COMMUNICATION AND ANALYSIS



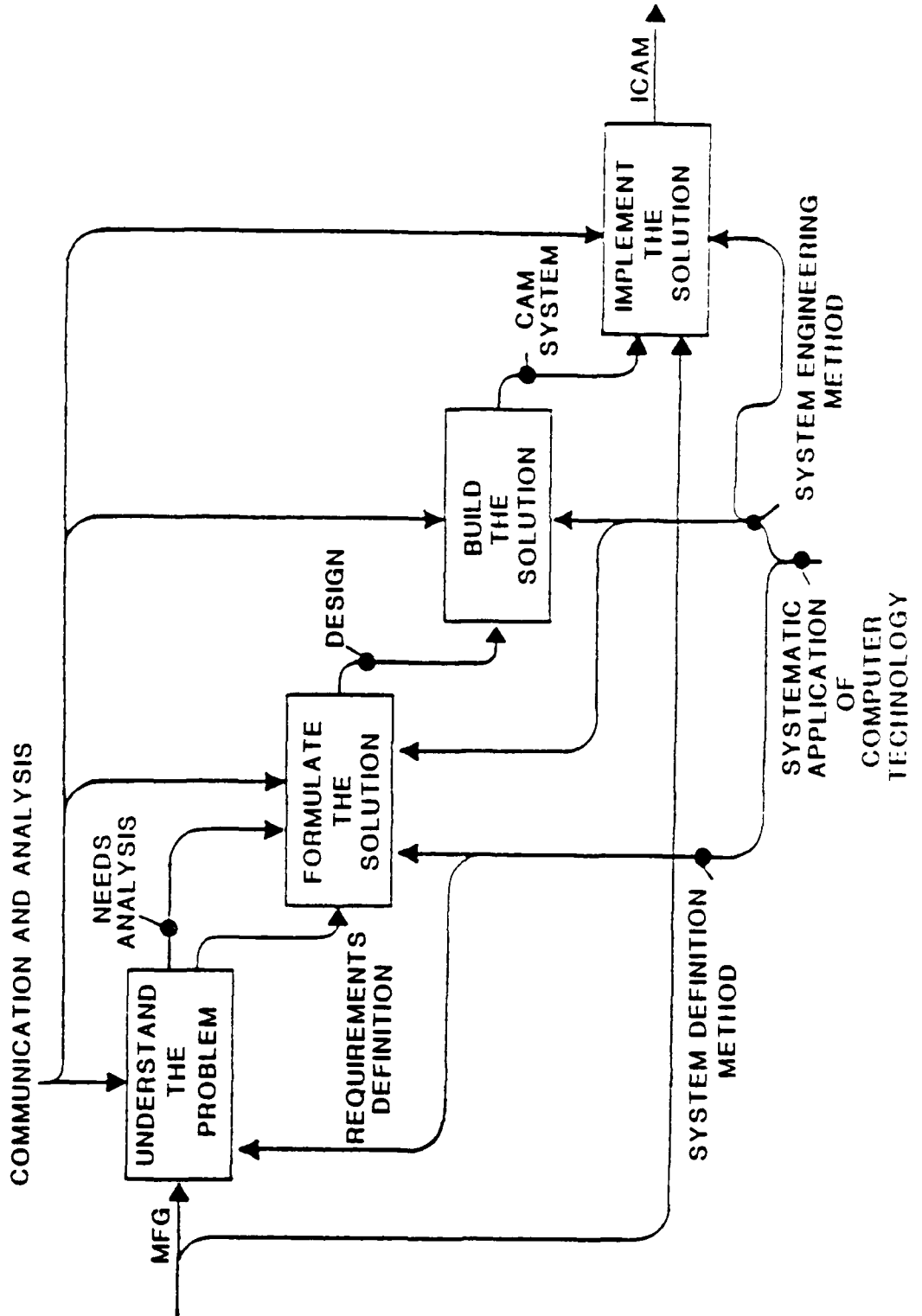
SYSTEMATIC APPLICATION  
OF  
COMPUTER TECHNOLOGY

# IMPROVE PRODUCTIVITY

## COMMUNICATION AND ANALYSIS



# IMPROVE PRODUCTIVITY

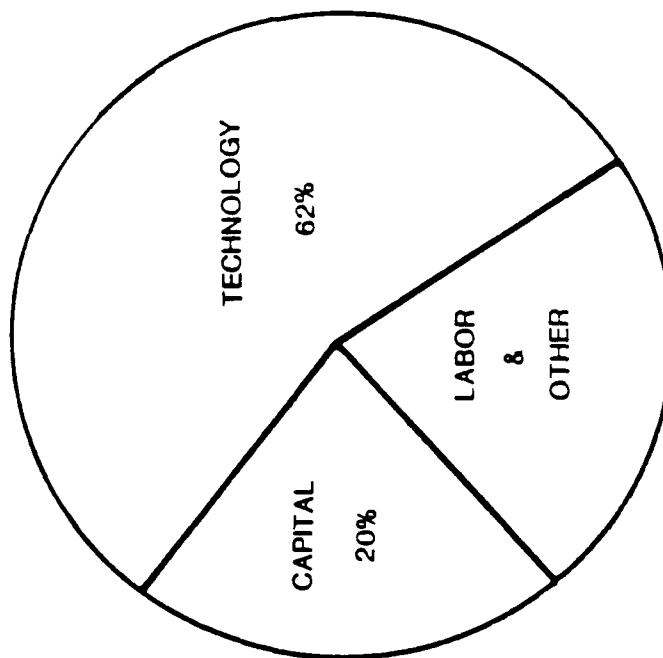


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8 September 1983

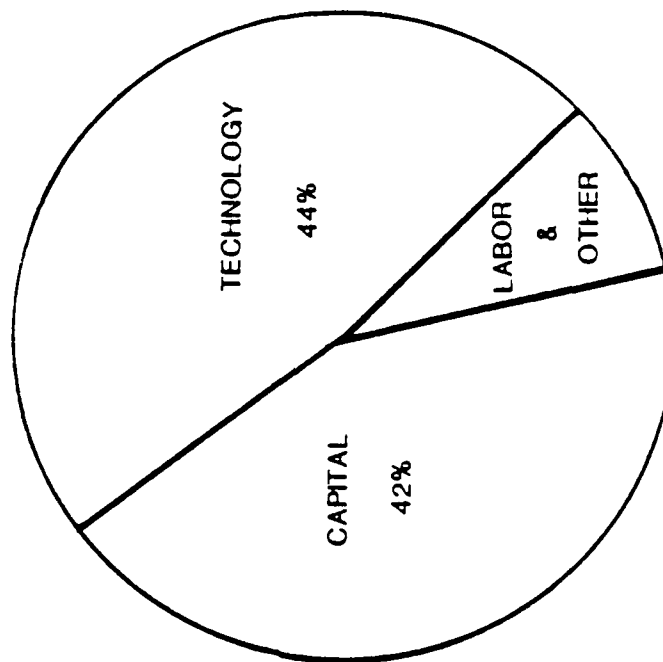
# **MANUFACTURING TECHNOLOGY MODERNIZATION PROGRAM (TECH MODS)**

# CONTRIBUTIONS TO PRODUCTIVITY INCREASES

## NCOP



## DOC

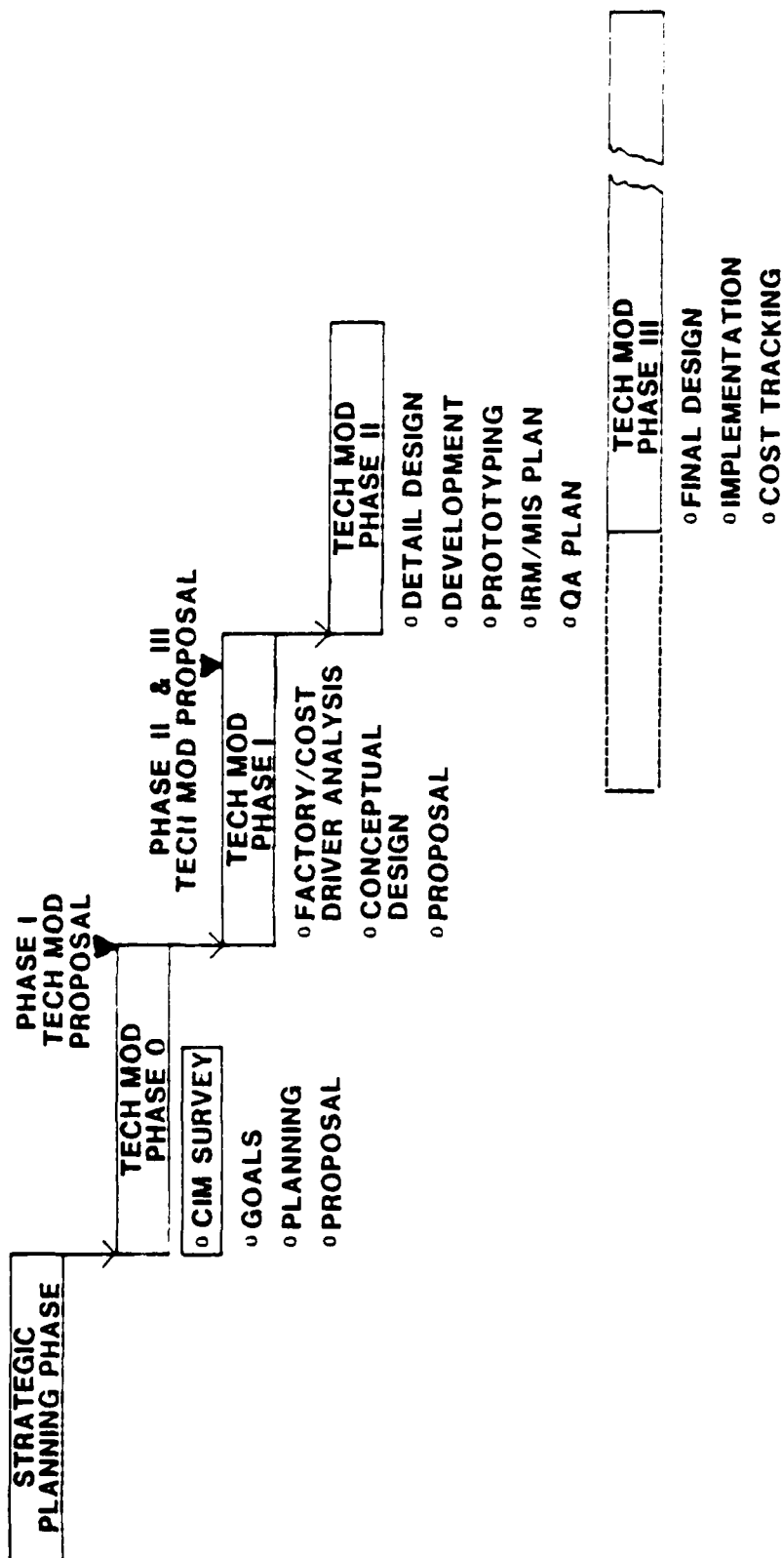


CAPITAL-31% AVG  
TECHNOLOGY-53% AVG

NCOP - NATIONAL COUNCIL ON  
PRODUCTIVITY - DENISON

DOC - DEPARTMENT OF COMMERCE  
CHRISTENSEN, CUMMINGS &  
JORGENSEN

# TECHNOLOGY MODERNIZATION FRAMEWORK



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8 September 1983



# TECH MOD CONCEPT

## PARTNERSHIP TO IMPROVE PRODUCTIVITY

### INDUSTRY

- MODERNIZE MANUFACTURING FACILITIES
- INVEST IN NEW SYSTEMS, NEW EQUIPMENT AND FACILITY IMPROVEMENTS
- IMPLEMENT IMPROVED SYSTEMS
- REDUCE COST OF WEAPONS SYSTEMS
- WINS
- LARGER PROFIT AND MORE COMPETITIVE POSITION WITH REDUCED FINANCIAL RISK

### GOVERNMENT

- PROVIDE INCENTIVES
- FUND ANALYSIS AND DESIGN
- PROVIDE TERMINATION LIABILITY PROTECTION
- PROVIDE AWARD FEES
- SHARE SAVINGS
- WINS
- MORE BANG FOR THE BUCK

# **TECH MOD PROGRAMS**

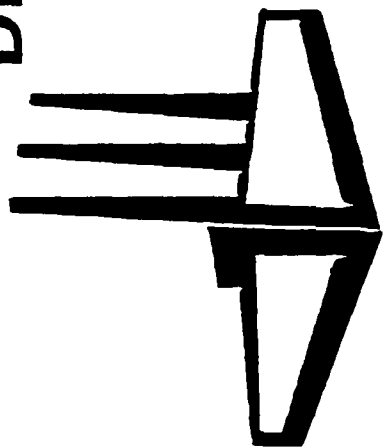
---

- ESTABLISH NEW PRODUCTION PROCESSES
- PROVIDE TECHNOLOGY TRANSFER
- STIMULATE IMPLEMENTATION & INVESTMENT
- DIRECTLY SUPPORTS SMALL BUSINESS & B/SIC INDUSTRIES (30-40%)
- BUILD UPON R&D PRECURSOR DEMONSTRATIONS
- IMPACT ACQUISITION & OPERATIONS & MAINTENANCE ROI

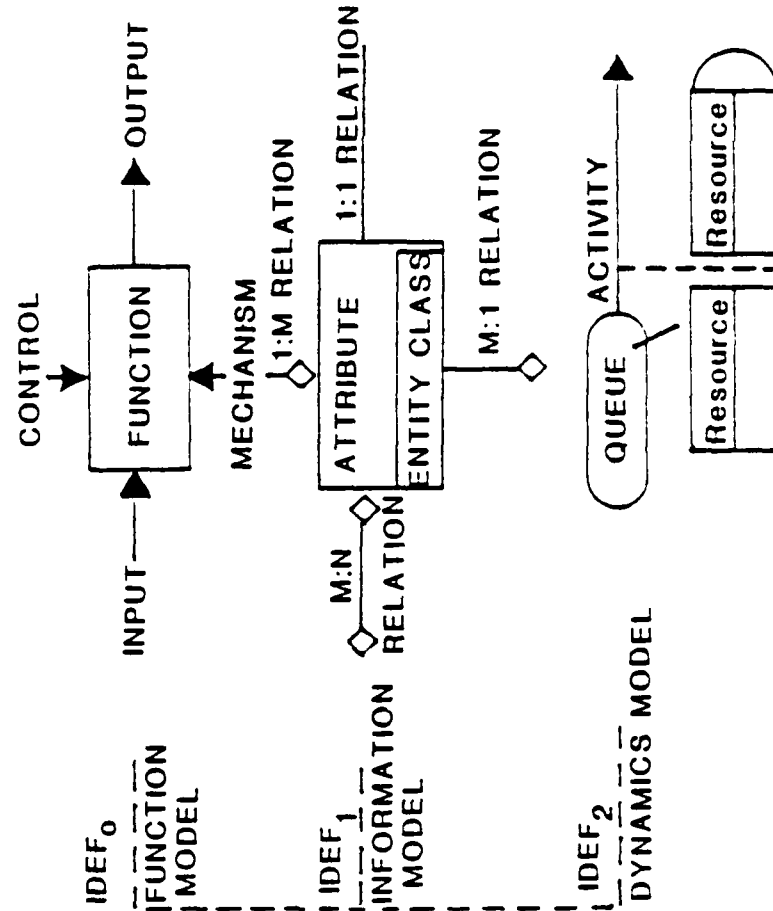
FTR110410000U  
8 September 1983

# ICAM ANALYTICAL / PLANNING TOOLS

# IDEF - A SYSTEM DEFINITION METHOD

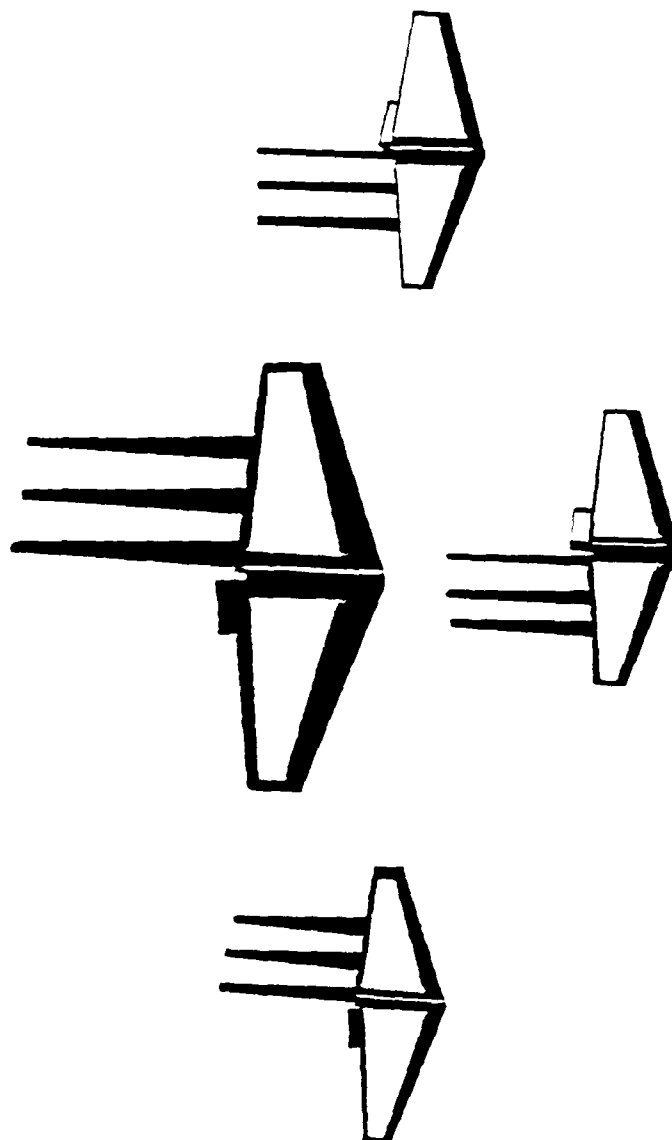


Manufacturing

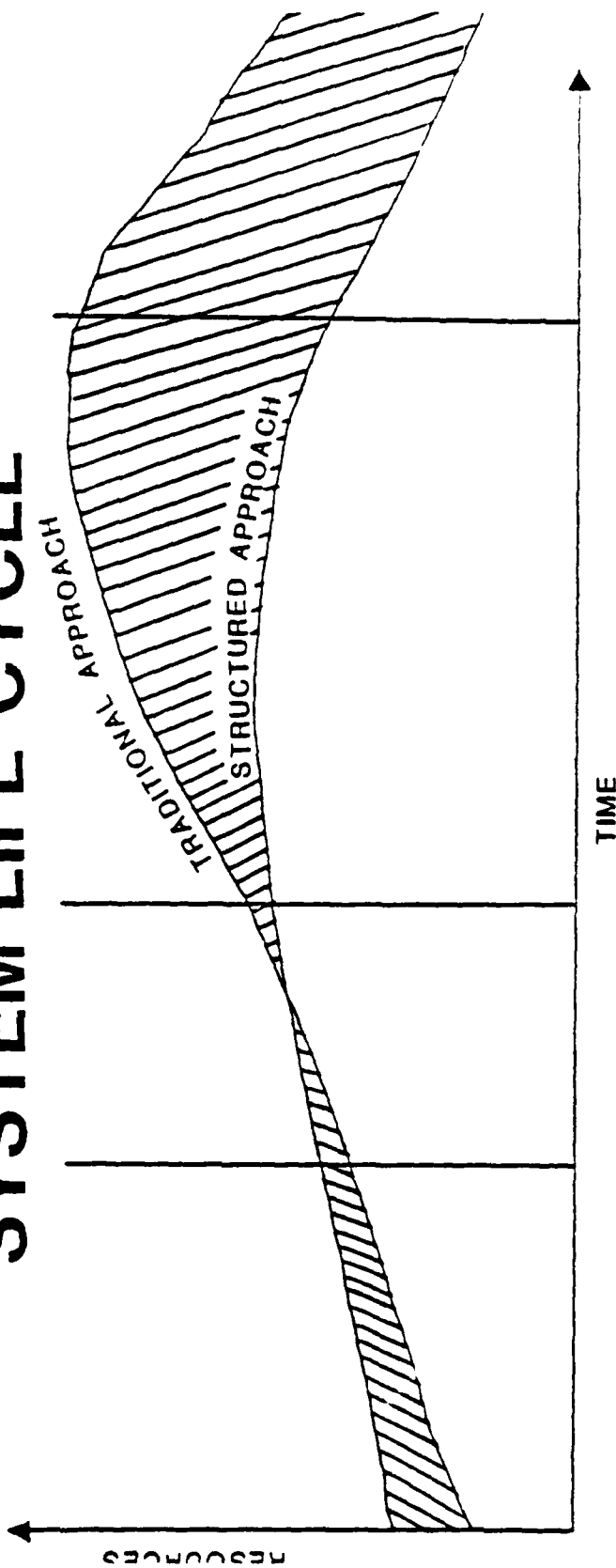


# ICAM

## IDEF → ARCHITECTURE



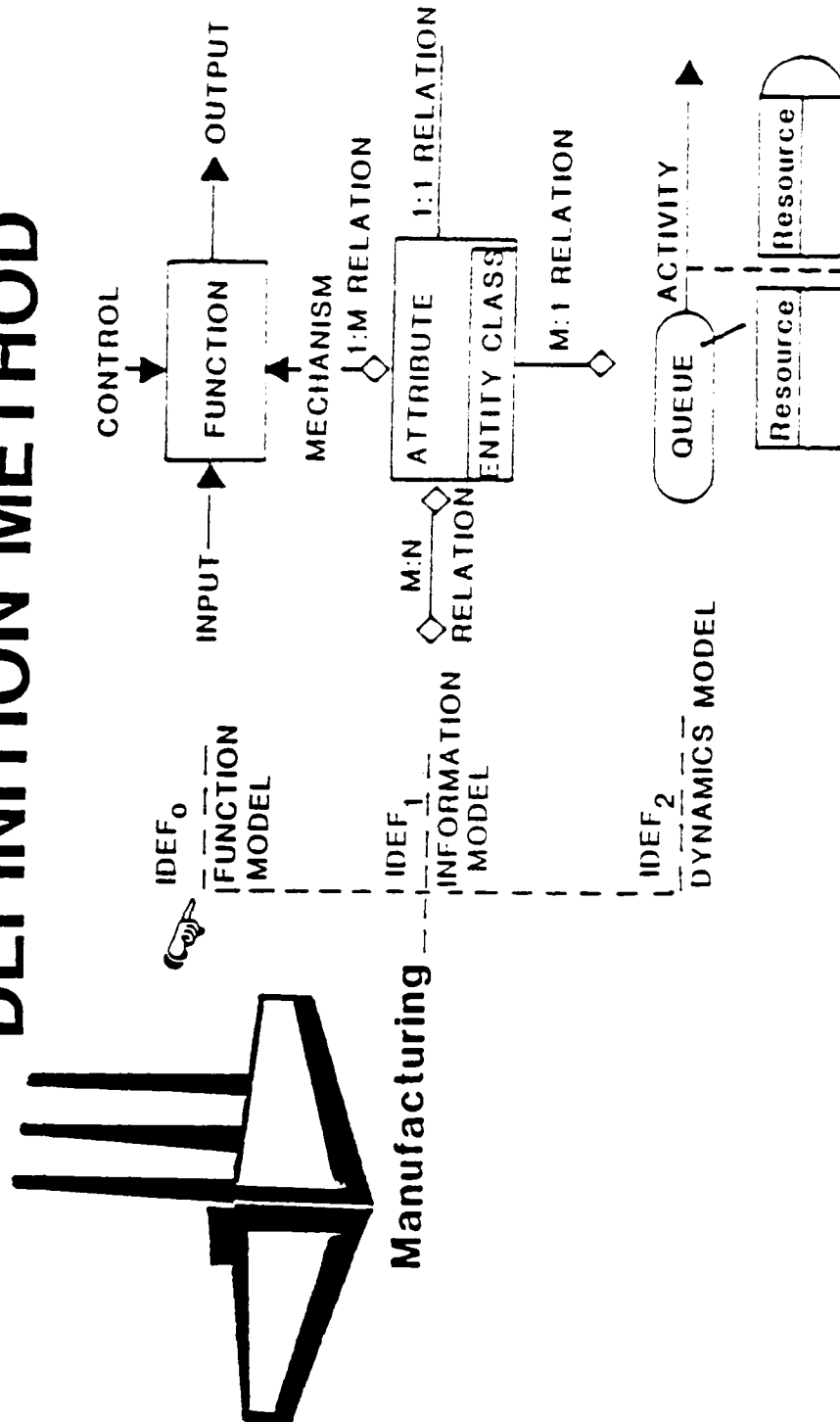
# IDEF → ARCHITECTURE SYSTEM LIFE CYCLE



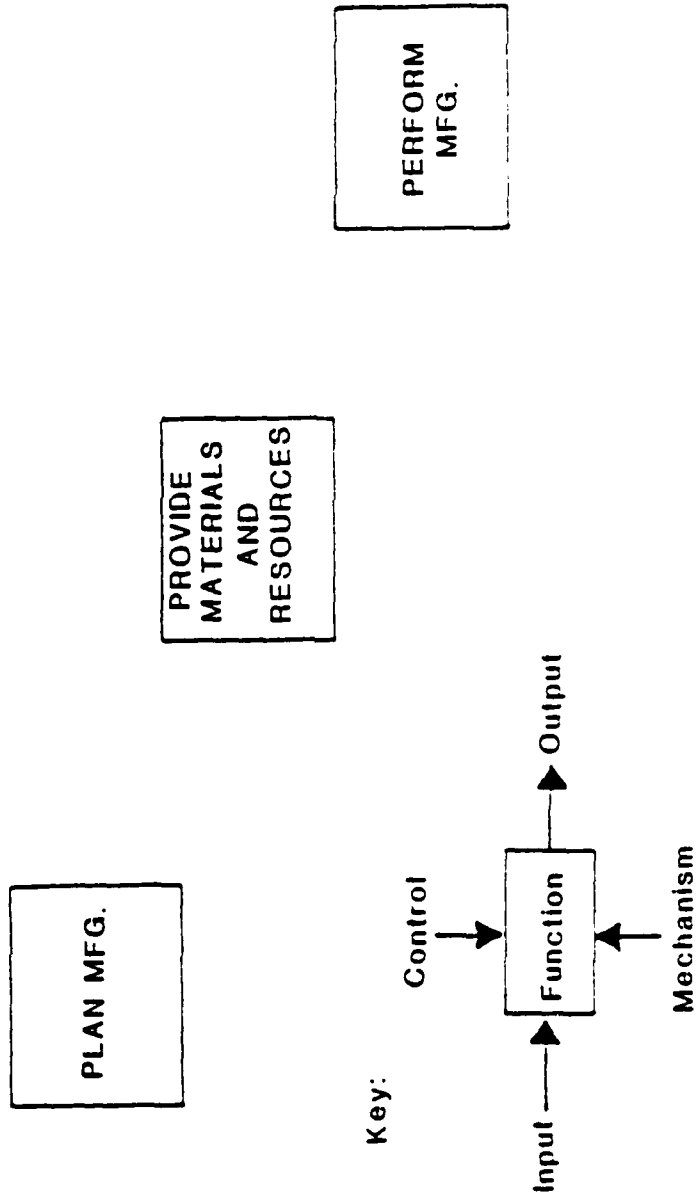
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UNDERSTANDING PROBLEM	DESIGN	SOLUTION BUILDING	INSTALL & USE
<ul style="list-style-type: none"> <li>● NEEDS ANALYSIS</li> <li>● REQUIREMENTS DEFINITION</li> </ul>	<ul style="list-style-type: none"> <li>● PRELIMINARY</li> <li>● DETAIL SPECIFICATION</li> </ul>	<ul style="list-style-type: none"> <li>● CONSTRUCTION, VERIFICATION, TEST</li> <li>● INTEGRATION, VALIDATION, TEST</li> </ul>	<ul style="list-style-type: none"> <li>● IMPLEMENTATION</li> <li>● USER ACCEPTANCE</li> <li>● MAINTENANCE</li> </ul>

# IDEF - A SYSTEM DEFINITION METHOD

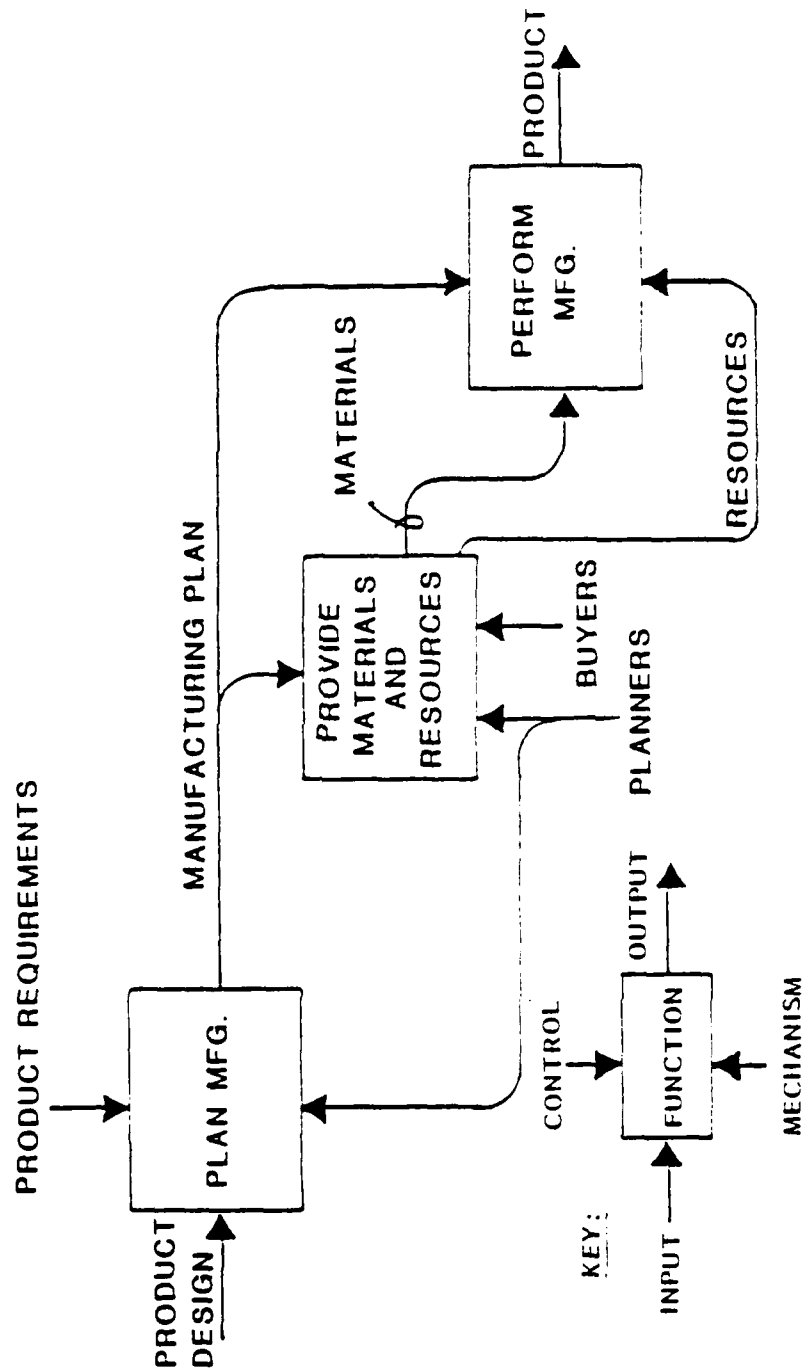


# IDEF<sub>0</sub> → FUNCTION MODEL

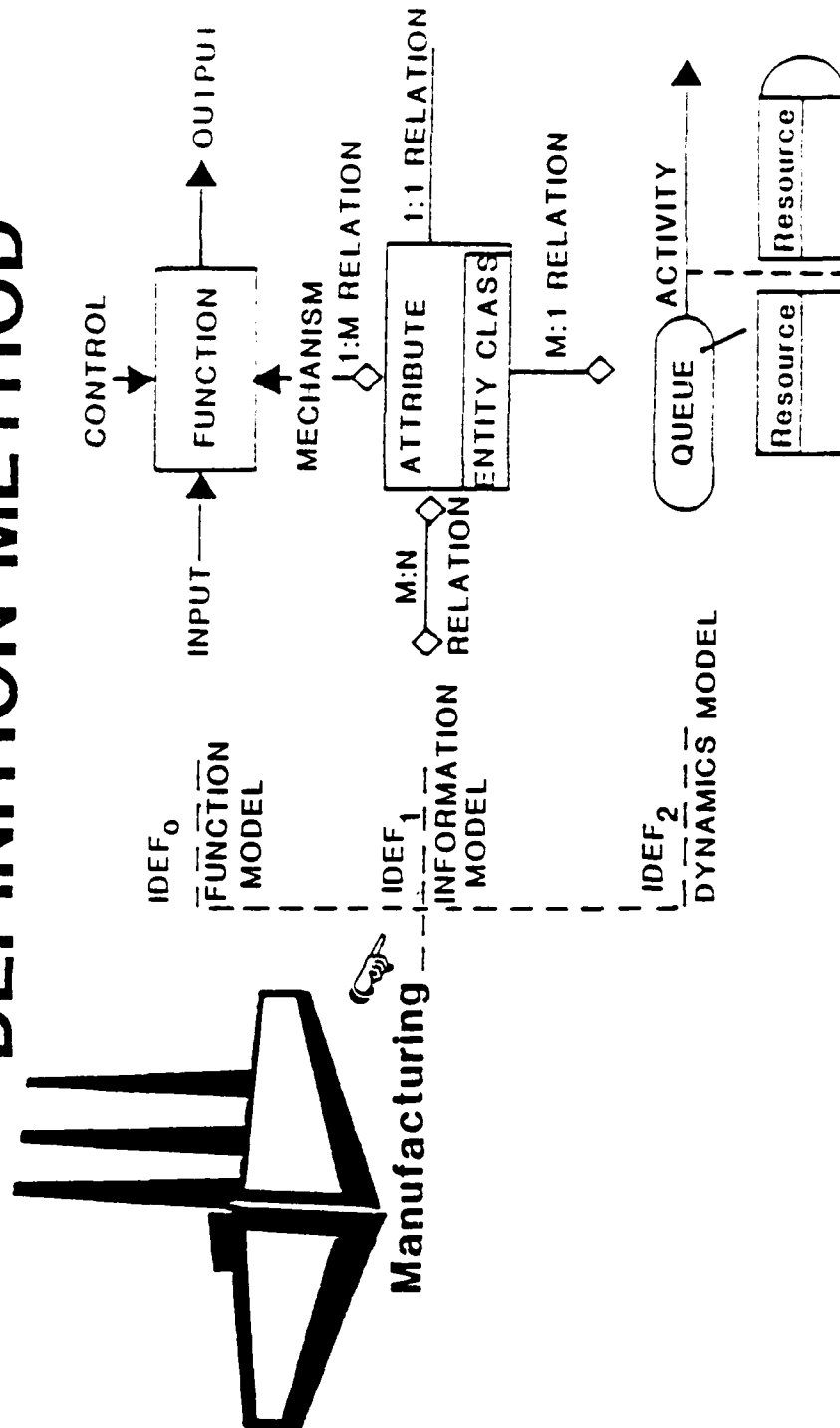




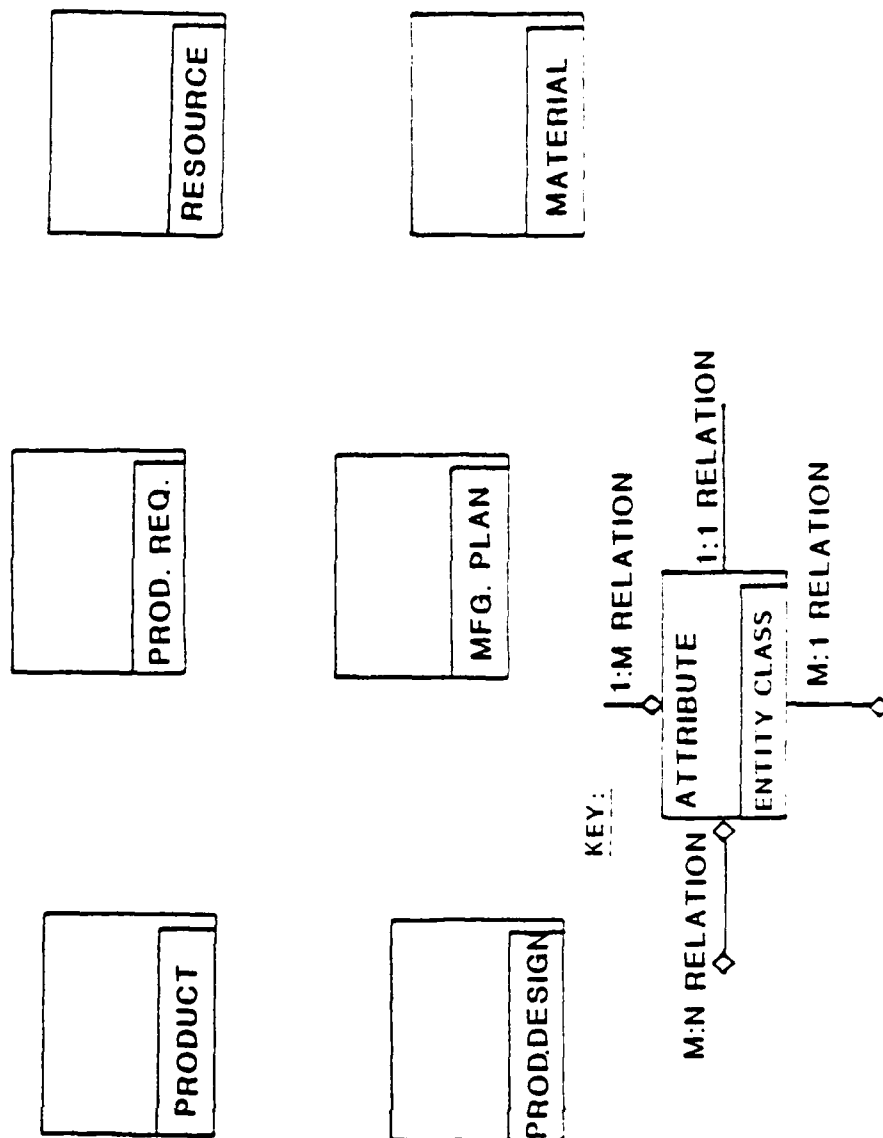
# IDEF<sub>0</sub> → FUNCTION MODEL



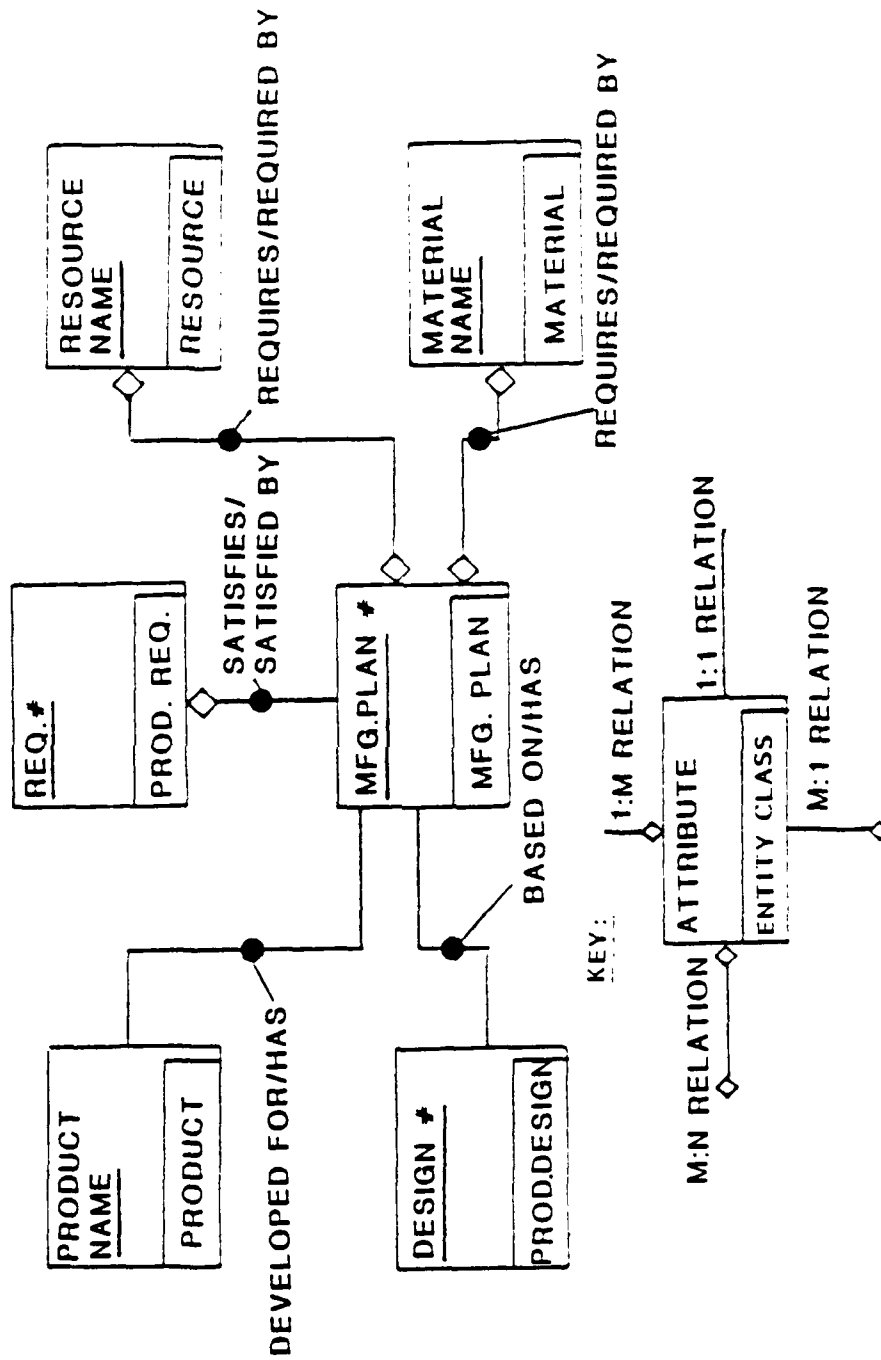
# IDEF - A SYSTEM DEFINITION METHOD



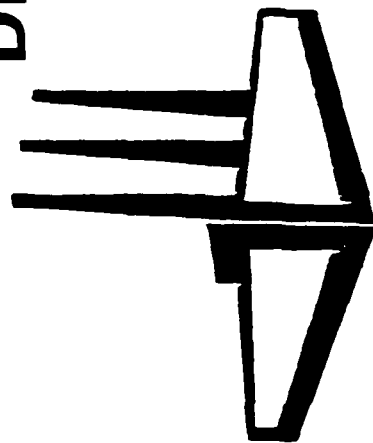
# IDEF<sub>1</sub> → INFORMATION MODEL



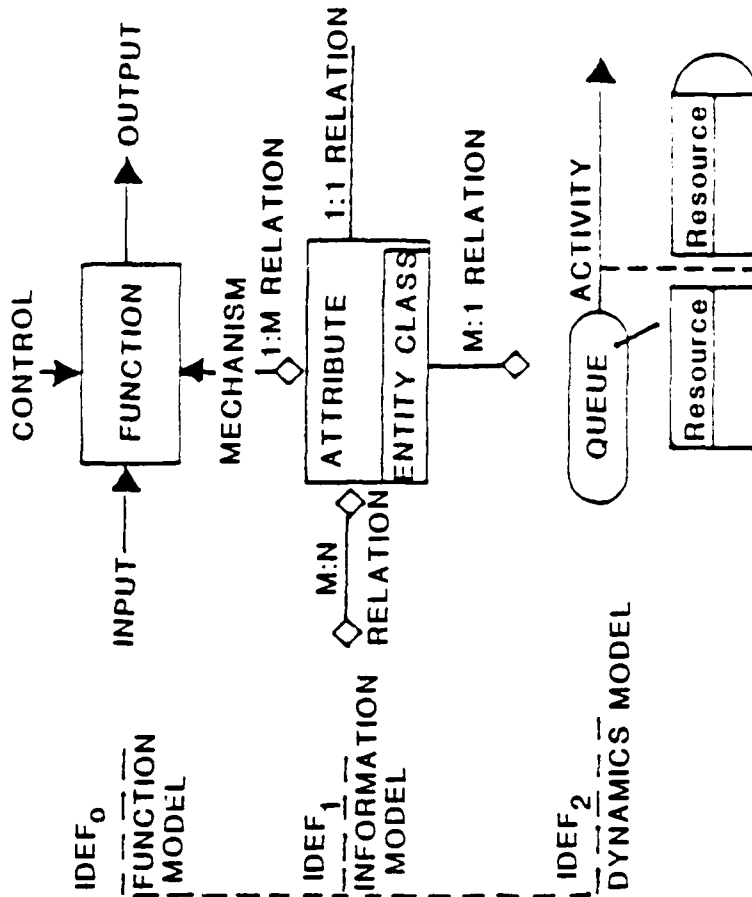
# IDEF<sub>1</sub> → INFORMATION MODEL



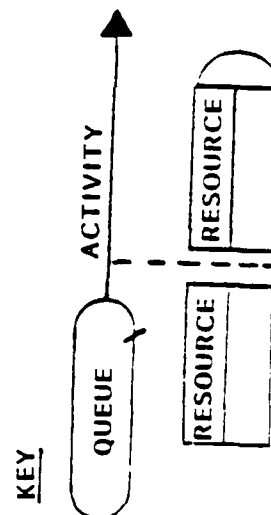
# IDEF - A SYSTEM DEFINITION METHOD



Manufacturing

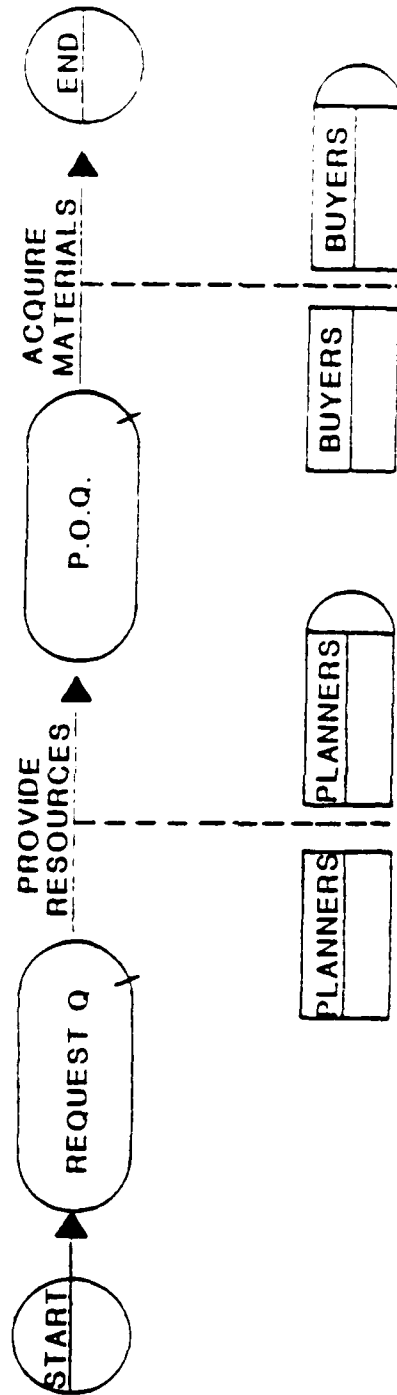


# IDEF<sub>2</sub> → DYNAMICS MODEL

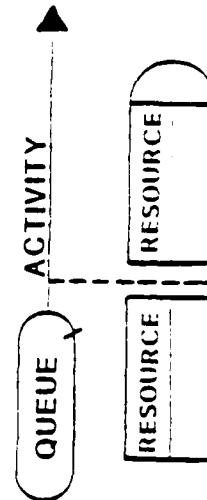


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8 September 1983

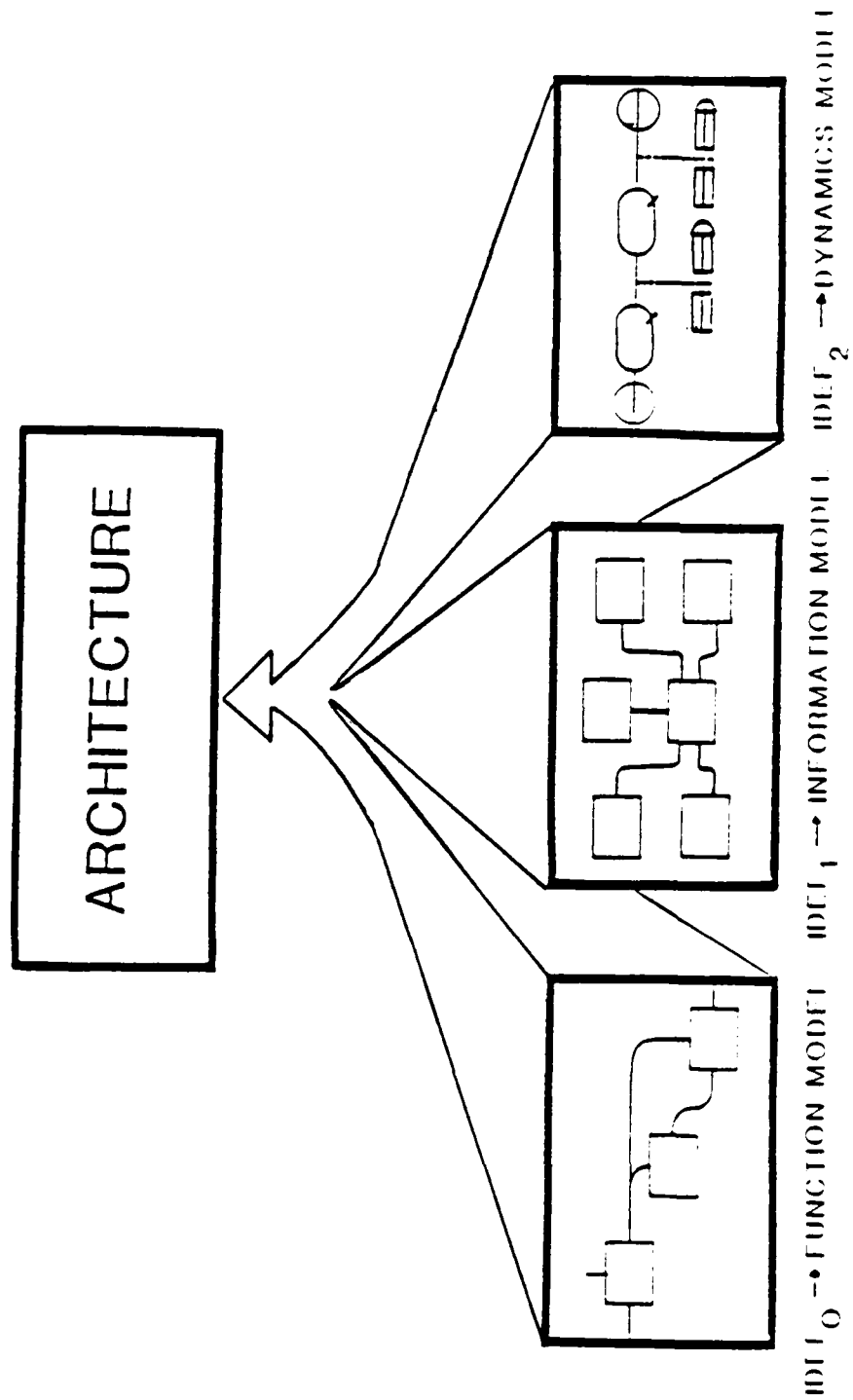
# IDEF<sub>2</sub> → DYNAMICS MODEL



KEY

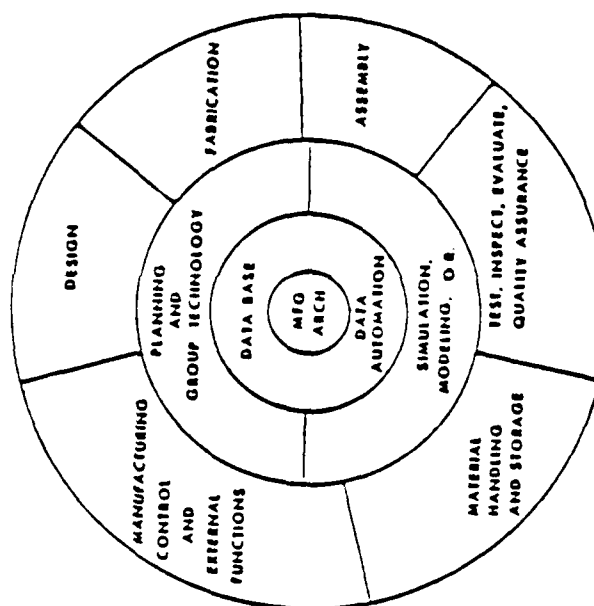


# ARCHITECTURE

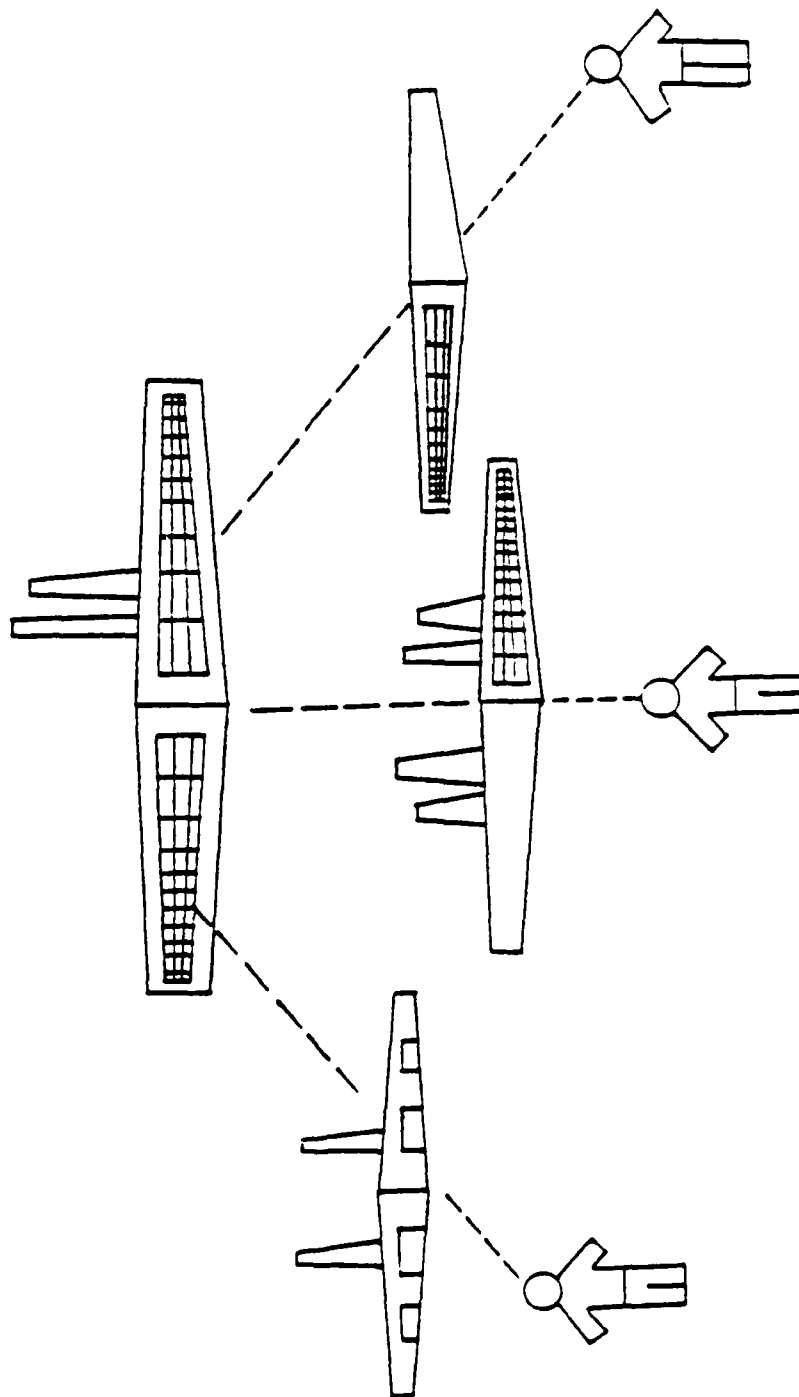




# ICAM INTEGRATED COMPUTER-AIDED MANUFACTURING

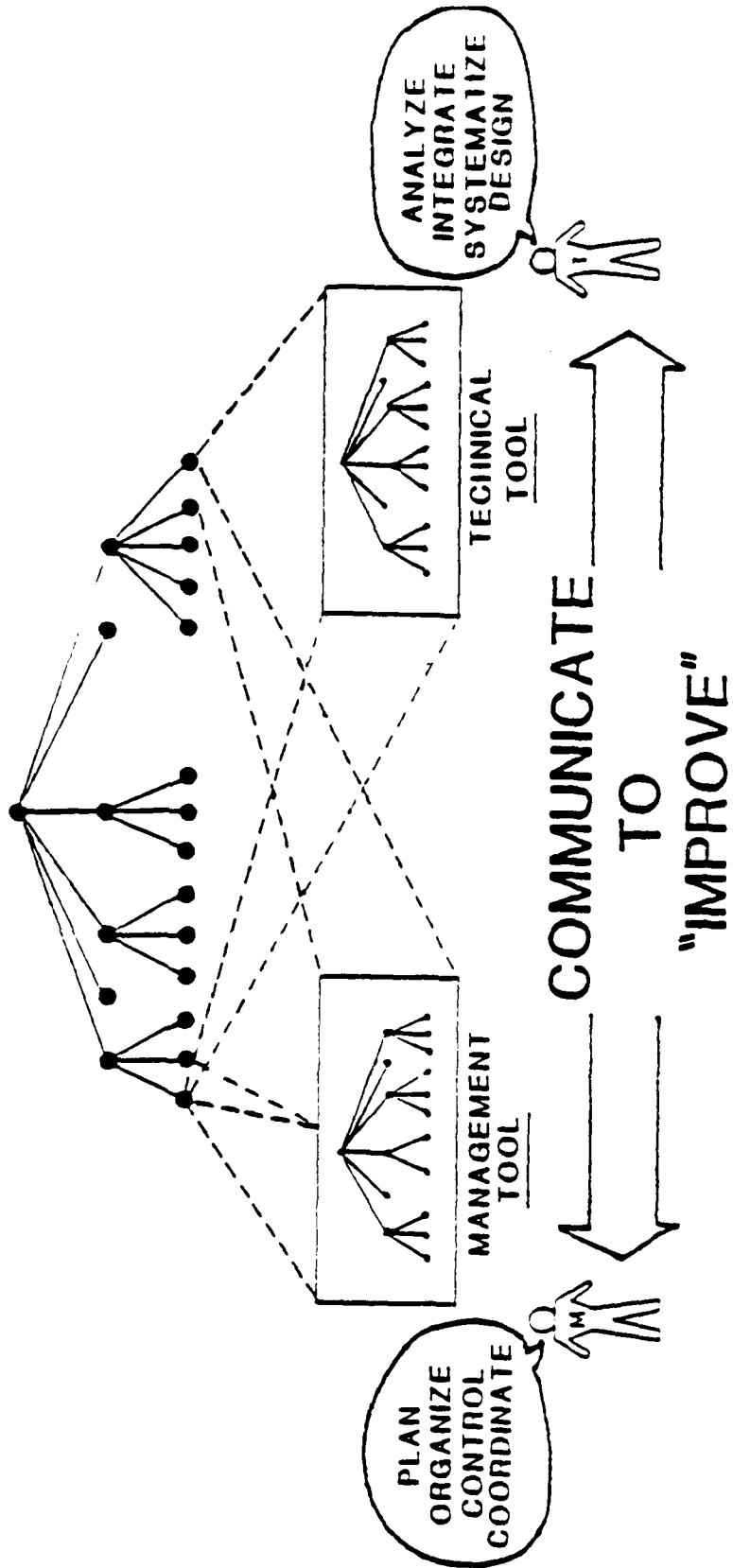


# ARCHITECTURE STANDARD FOR COMMUNICATION



# ARCHITECTURE

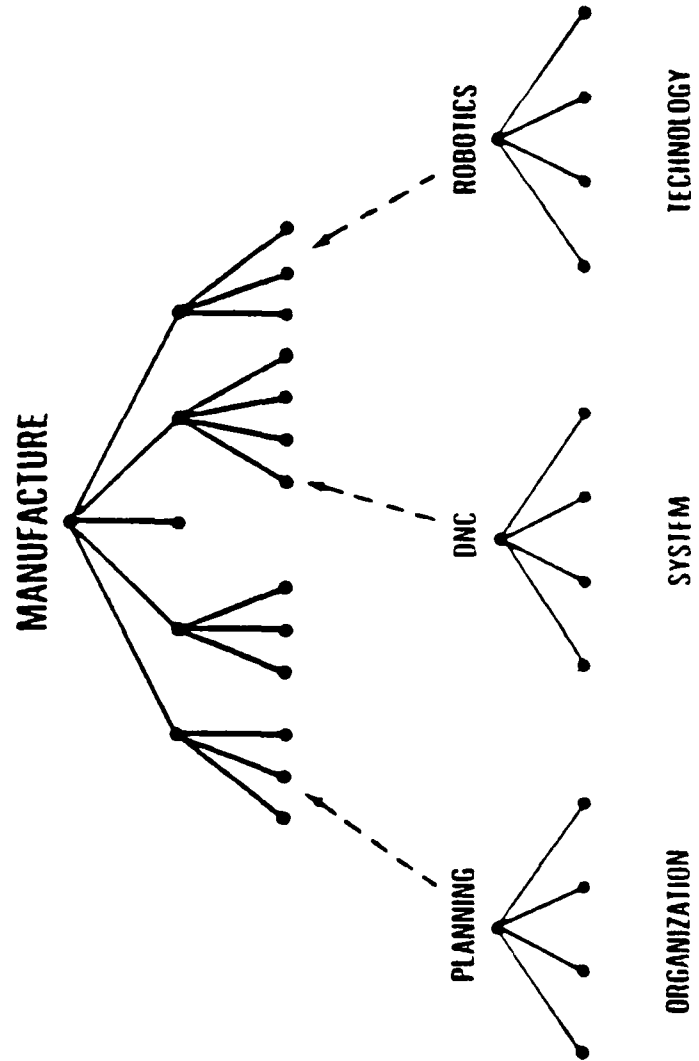
## MANUFACTURING



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# STANDARD FOR COMMUNICATION

---



IDEF IS THE METHOD

ARCHITECTURE IS THE MEANS

PRODUCTIVITY IS THE OBJECTIVE

## ICAM INTEGRATED SHEET METAL CENTER (ISMC)


---


MACHINE UTILIZATION ----- 

NUMBER OF:


● MACHINES ----- 

● FLOOR SPACE ----- 

● PEOPLE ----- 

THROUGHPUT ----- 

COST:

● INITIAL ----- 

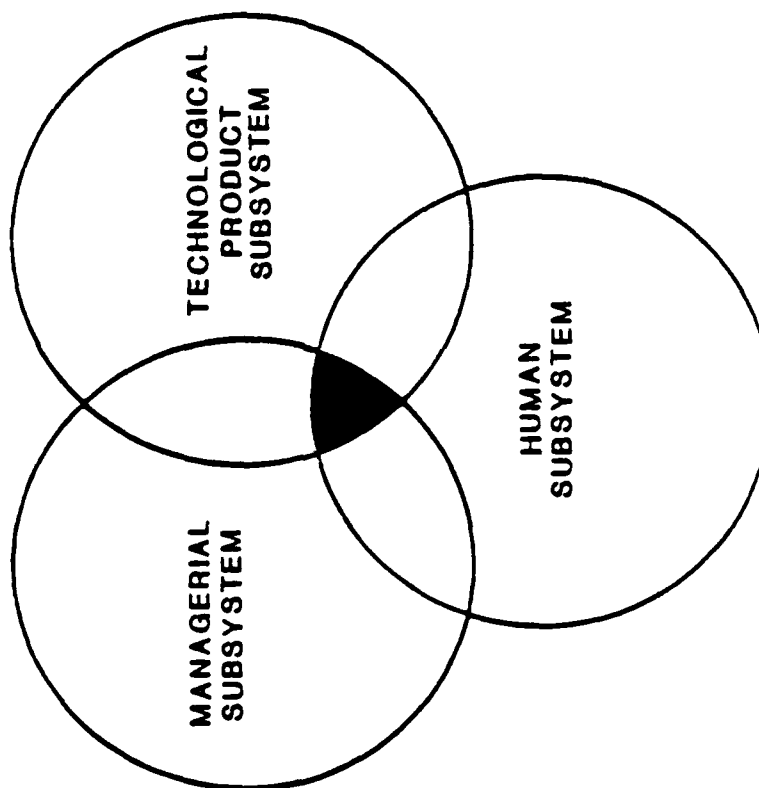
● ANNUAL ----- 

**INTEGRATED  
STRATEGIC PLANNING  
AND  
INFORMATION RESOURCE  
MANAGEMENT**

# RESOURCE MANAGEMENT

CAPITAL  
RESOURCES

TIME  
RESOURCES



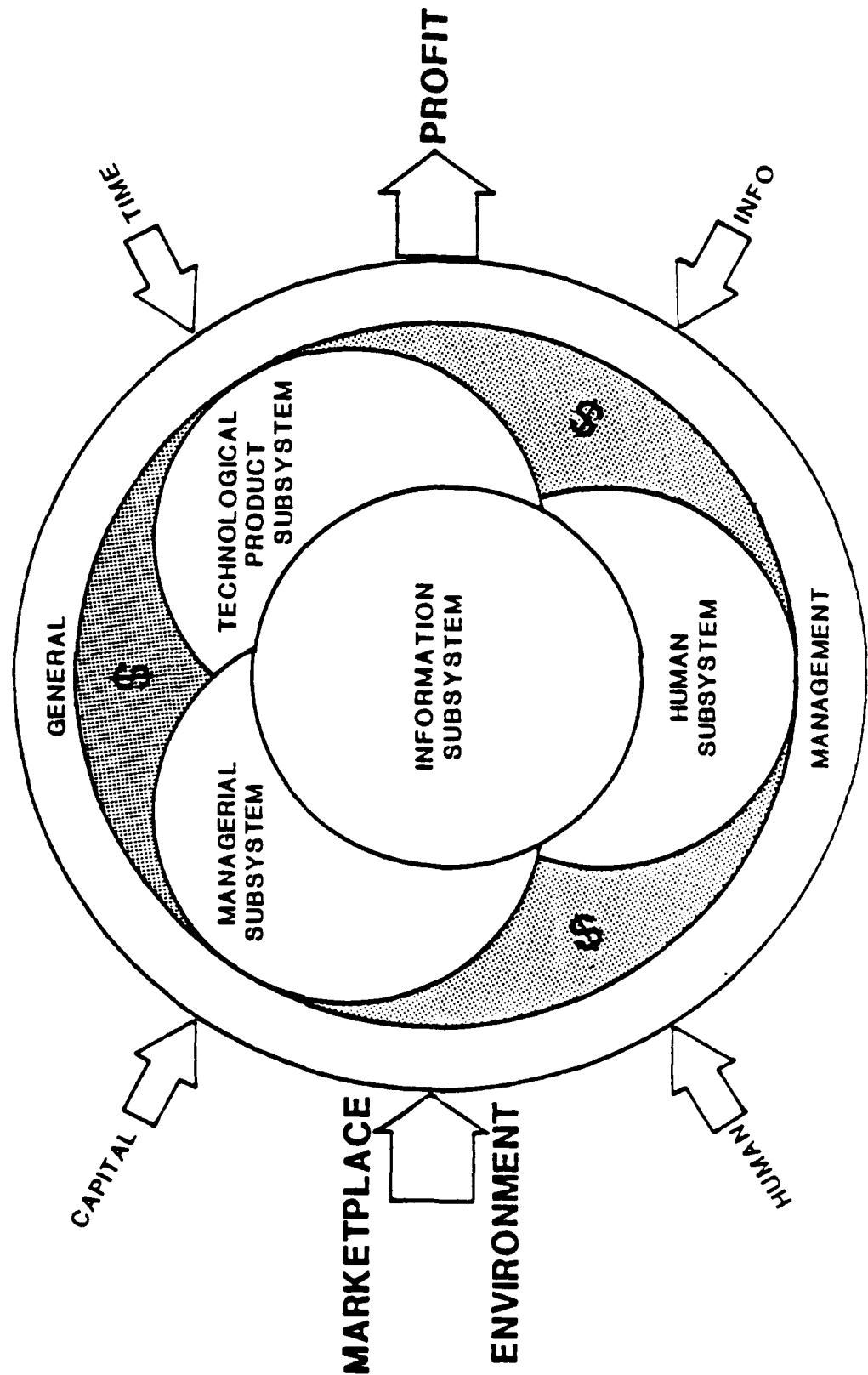
HUMAN  
RESOURCES

INFORMATION  
RESOURCES

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8 September 1983



# **INFORMATION RESOURCE MANAGEMENT**



## **INFORMATION RESOURCE MANAGEMENT (IRM)**

**"INFORMATION IS THE MANAGER'S MAIN TOOL,  
INDEED THE MANAGER'S "CAPITAL", AND IT IS HE  
WHO MUST DECIDE WHAT INFORMATION HE NEEDS  
AND HOW TO USE IT."**

**PETER DRUCKER-"MANAGING THE INFORMATION EXPLOSION"**

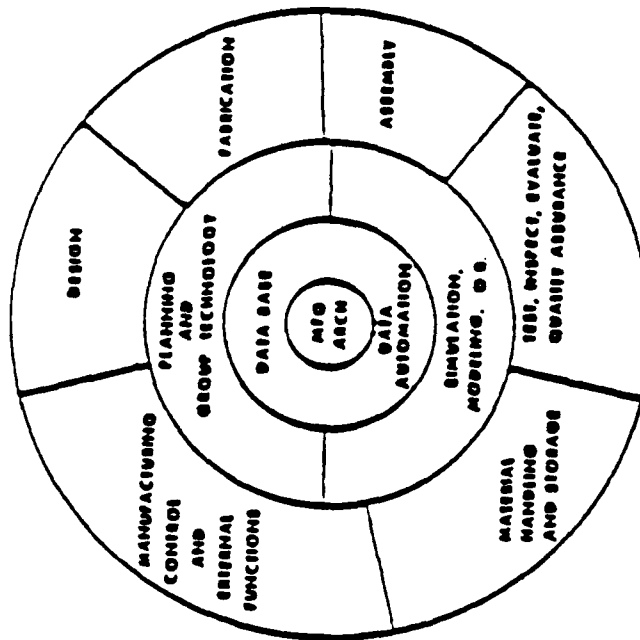
## INTEGRATED STRATEGIC PLANNING AND IRM

---

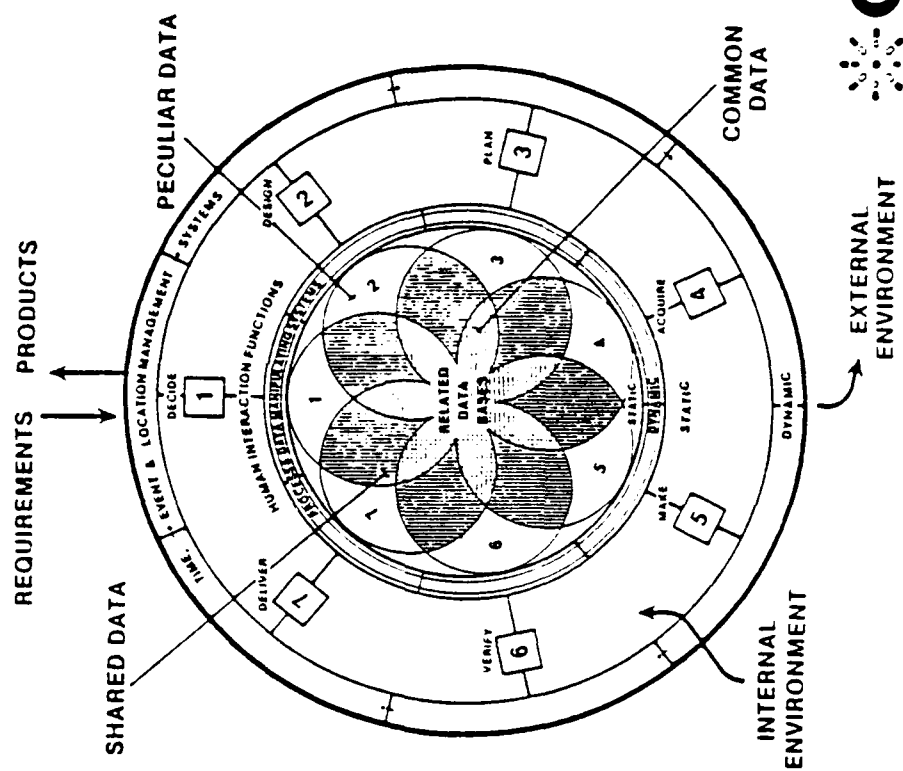
- "ONLY 19% OF THE COMPANIES SURVEYED HAVE INTEGRATED THEIR STRATEGIC PLANNING AND INFORMATION RESOURCE MANAGEMENT (IRM) SYSTEMS"
- "THE COMPANIES THAT DID SO OUTPERFORMED THE REST OF THE SAMPLE BY ABOUT 300% OVER FIVE YEARS ON SUCH MEASURES AS :
  - AVERAGE RETURN ON EQUITY
  - RETURN ON TOTAL CAPITAL
  - NEW PROFIT MARGINS"

(REF: A.T. KEARNEY, INC, MANAGEMENT CONSULTANT SURVEY OF 40 OF 500  
LARGEST U.S. INDUSTRIAL AND FINANCIAL INSTITUTIONS)

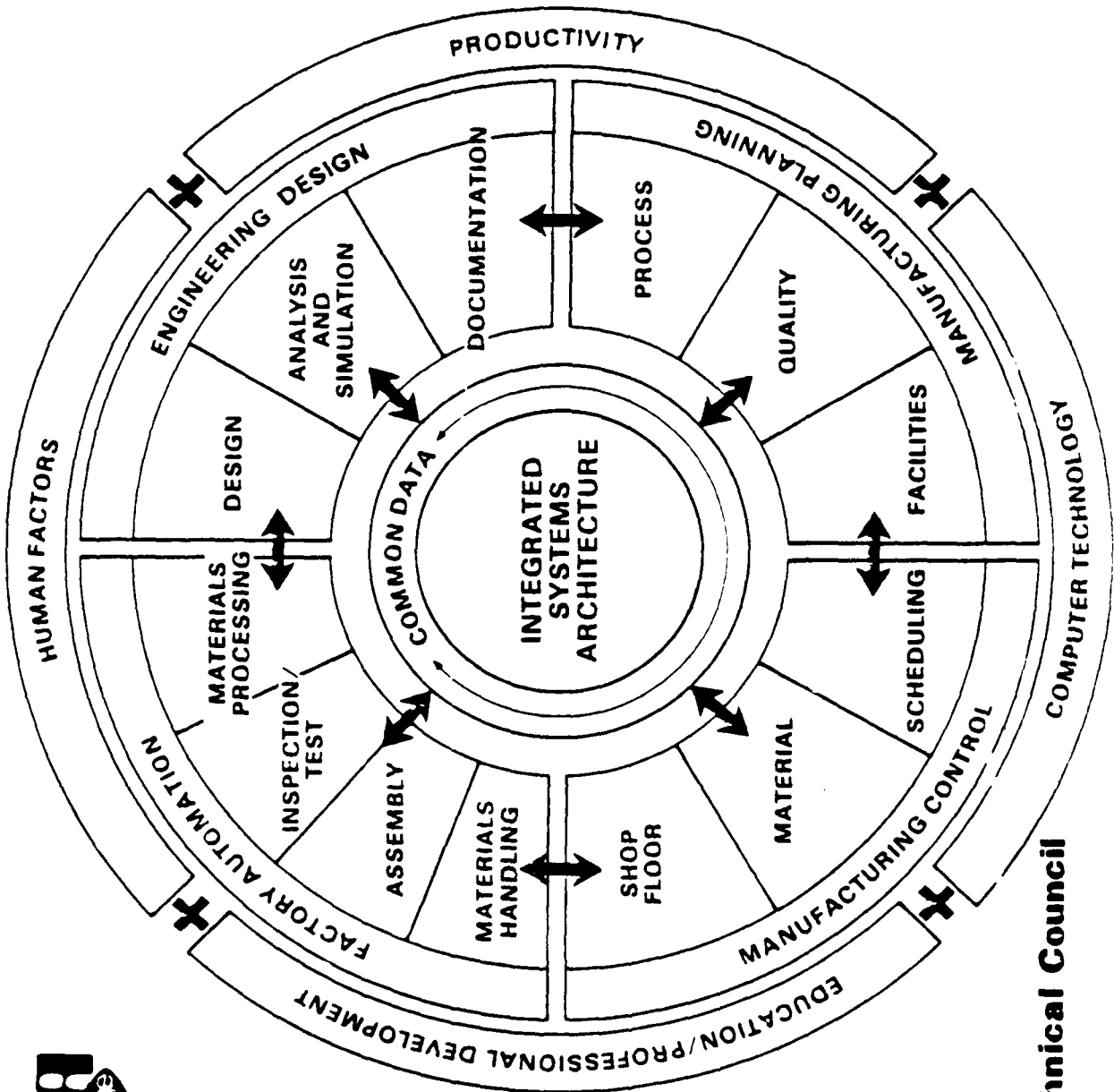
# ICAM INTEGRATED COMPUTER-AIDED MANUFACTURING



# DYNAMIC HUMAN DIRECTED COMPUTER-AIDED ACTIVITY MODEL



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8 September 1983



**CASA Technical Council**



## COMMON TERMINOLOGY

● FRAMEWORK

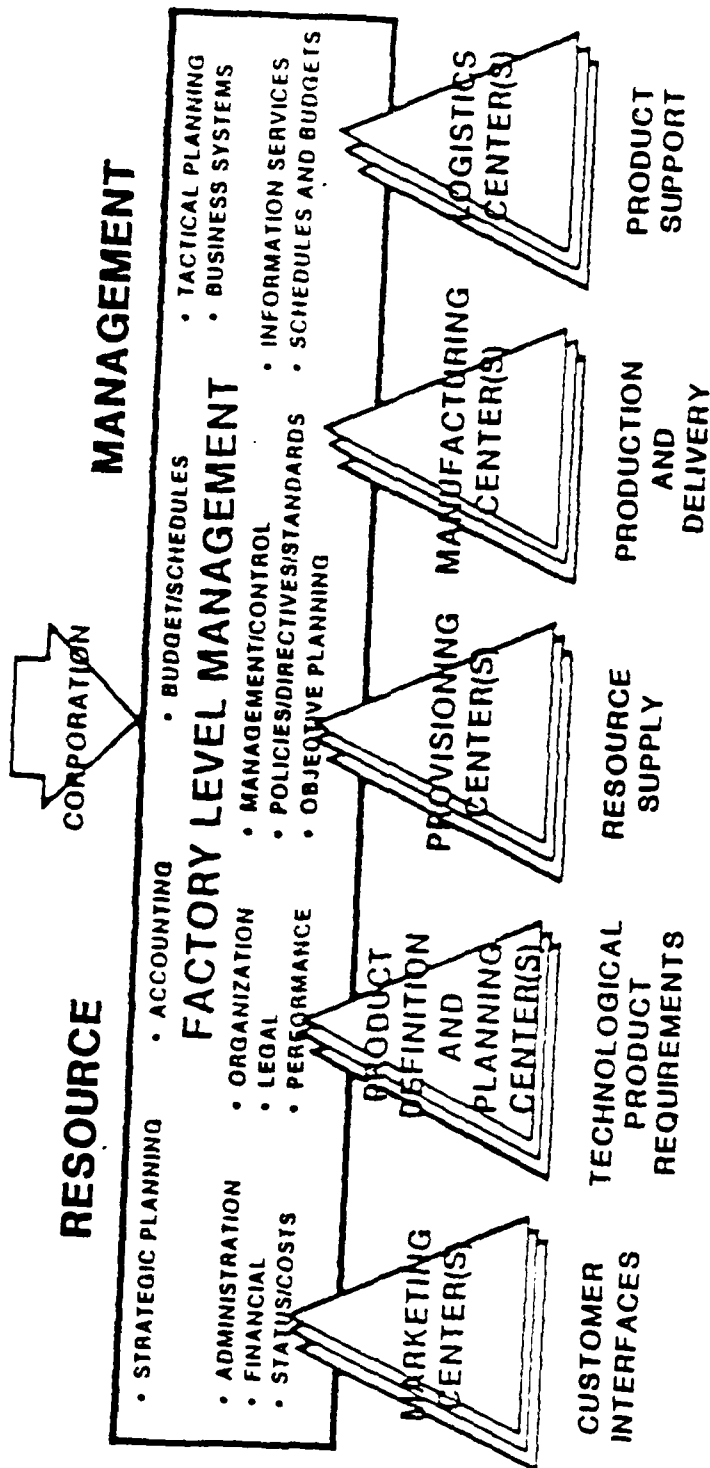
● ARCHITECTURE

● STRUCTURE

● "BLUE PRINT"

● "ROAD MAP"

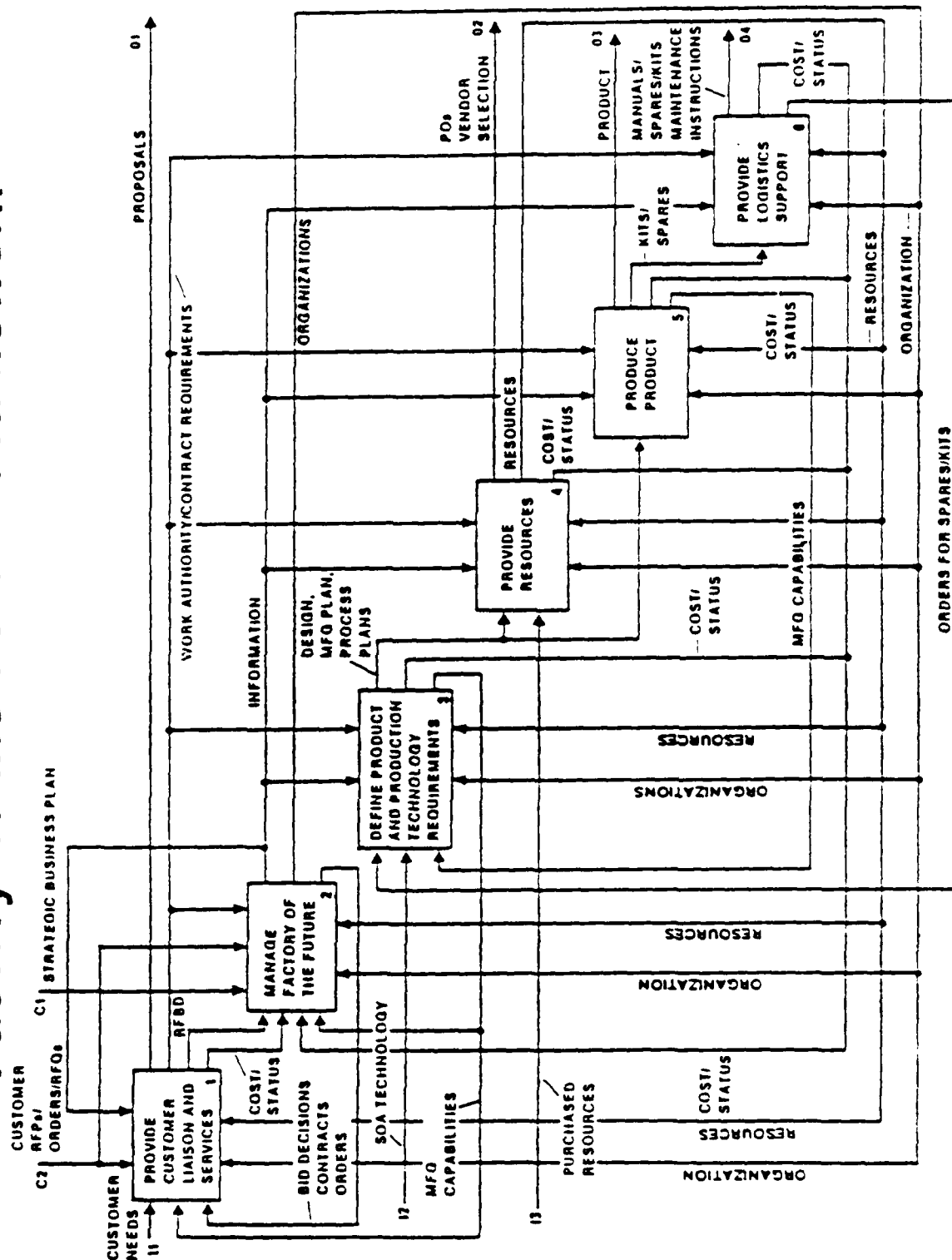
# FACTORY OF THE FUTURE FRAMEWORK



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8 September 1983

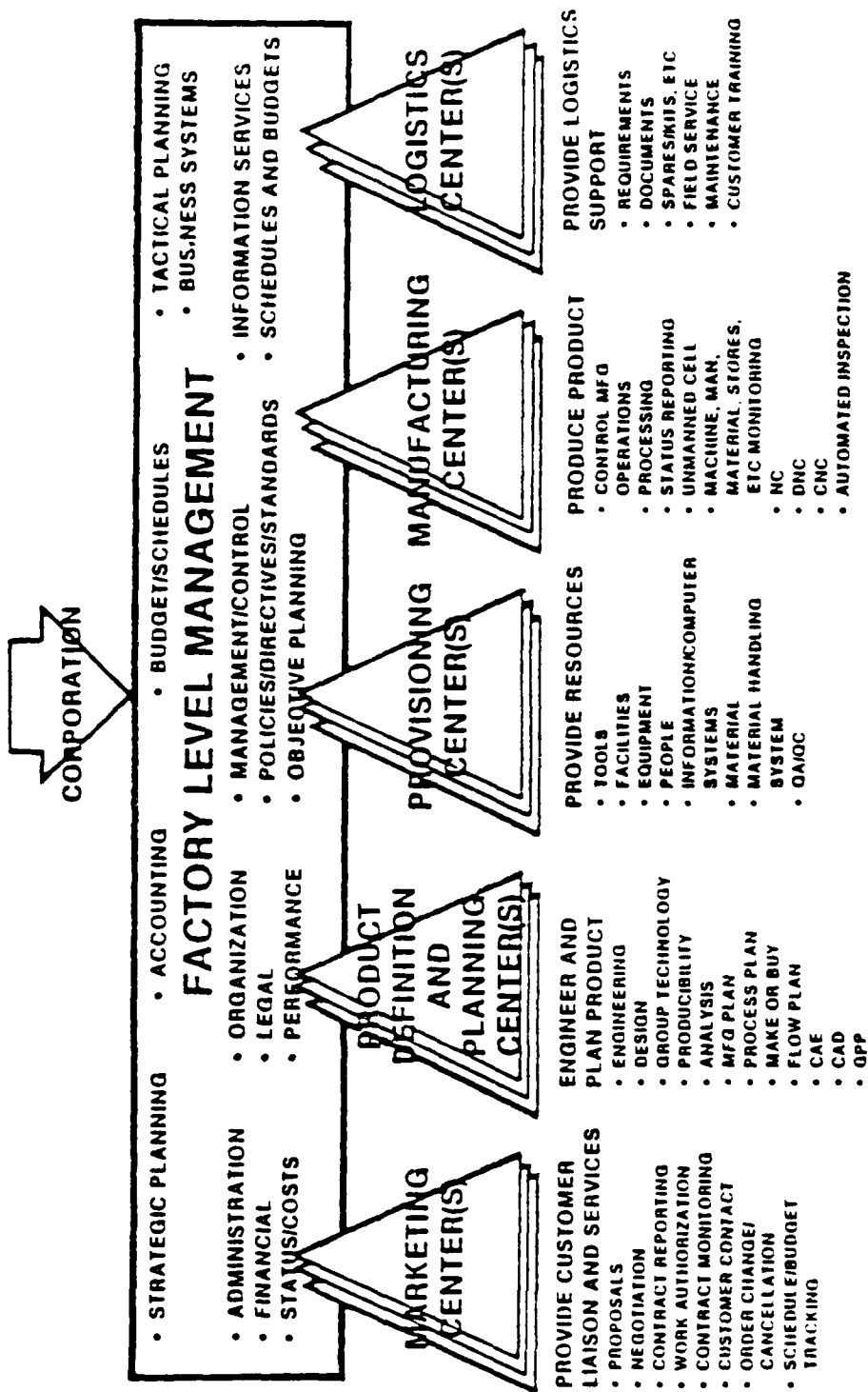


# Factory of the Future Framework



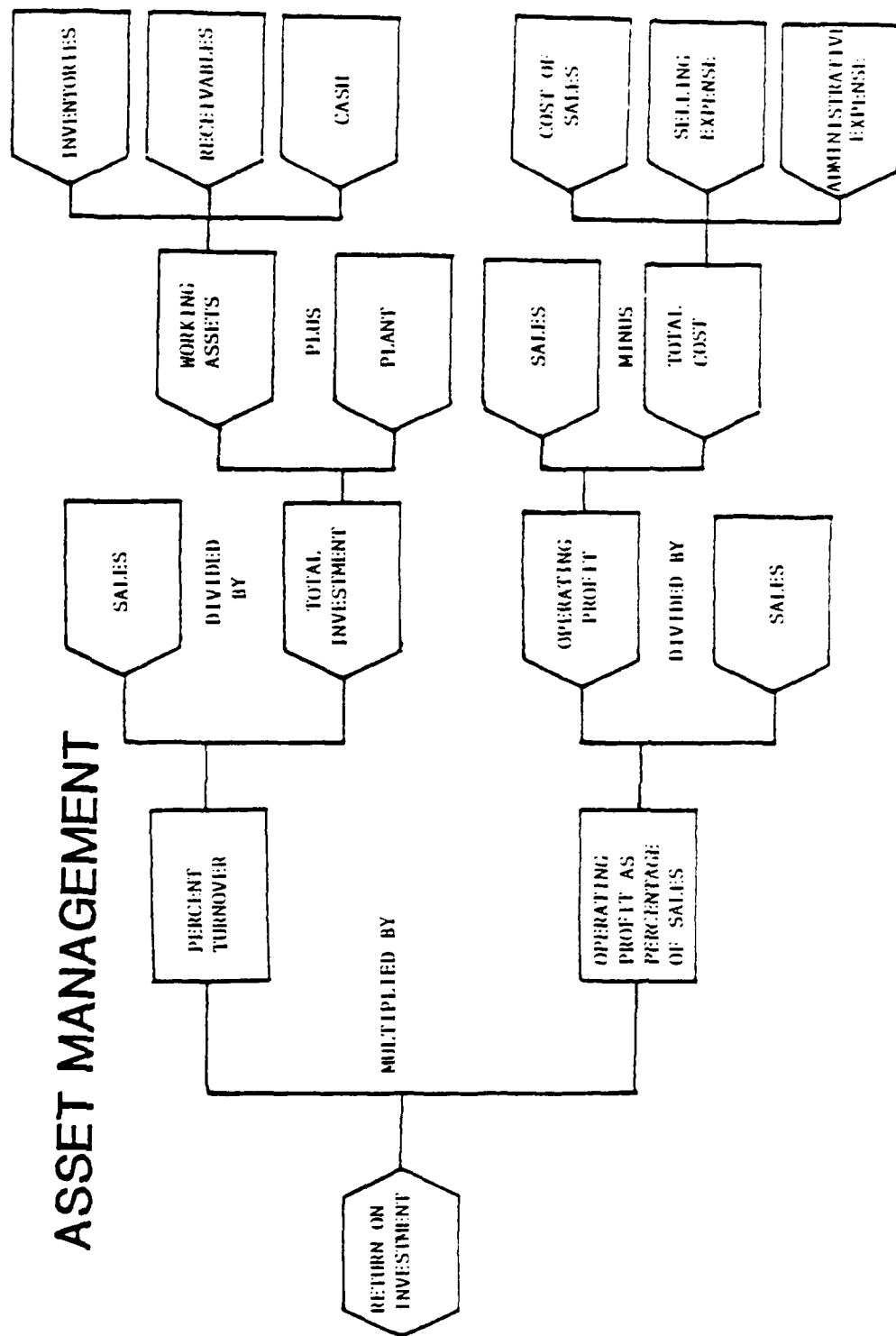
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8 September 1983

# FACTORY OF THE FUTURE FRAMEWORK



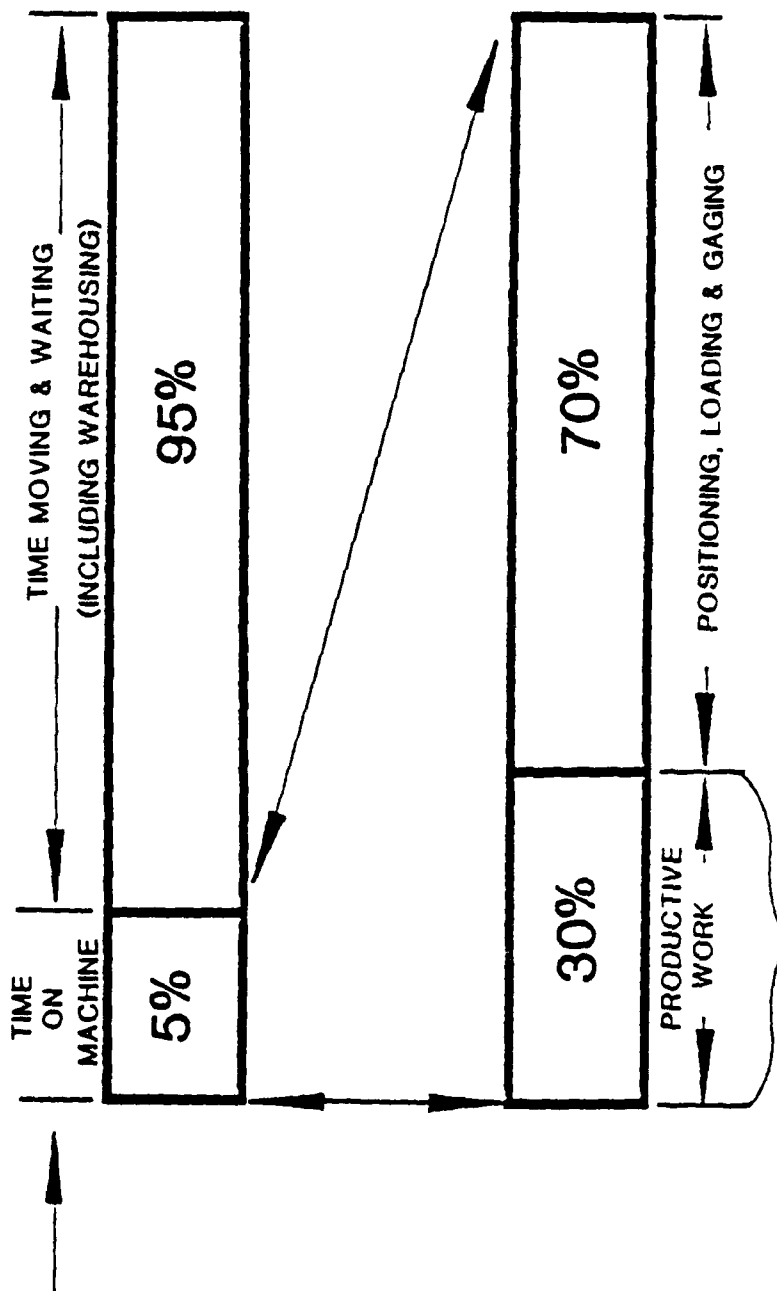
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8 September 1983

# CAPITAL VS. RETURN ON INVESTMENT (ROI)



# INVENTORY "TIME IN SHOP"

FTR110410000U  
8 September 1983



MANAGEMENT/MANUFACTURING ENGINEERING "MANUFACTURING ATTENTION"

# TIME MANAGEMENT

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8 September 1983

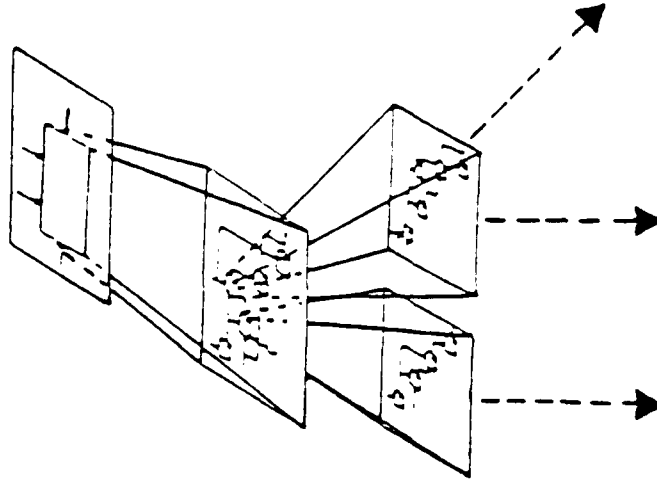
## NODE INDEX

### A-0 MANUFACTURE PRODUCT (CONTEXT)

#### A0 MANUFACTURE PRODUCT

- A1 PLAN FOR MANUFACTURE
  - A11 ASSUME A STRUCTURE AND METHOD OF MANUFACTURE
  - A12 ESTIMATE REQUIREMENTS, TIME, AND COST TO PRODUCE
  - A13 DEVELOP PRODUCTION PLANS
  - A14 DEVELOP SUPPORT ACTIVITIES PLANS
- A2 MAKE AND ADMINISTER SCHEDULES AND BUDGETS
  - A21 DEVELOP MASTER SCHEDULE
  - A22 DEVELOP COORDINATING SCHEDULES
  - A23 ESTIMATE COSTS AND MAKE BUDGETS
  - A24 MONITOR PERFORMANCE TO SCHEDULE AND BUDGET
- A3 PLAN PRODUCTION
  - A31 CONTROL PLANNING
  - A32 DETERMINE DETAILED METHOD OF MANUFACTURE
  - A33 DEVELOP PRODUCTION INSTRUCTIONS
  - A34 VALIDATE RELEASE PLANNING

## CORRESPONDING DECOMPOSITION STRUCTURE



## INFORMATION RESOURCE AND HUMAN RESOURCE MANAGEMENT

---

- THE PRODUCT OF ANY EMPLOYEE THAT DOES NOT LAY HANDS ON THE HARDWARE PRODUCT IS DATA AND/OR DECISIONS.
- EMPLOYEE "PARTICIPATION" IS DEPENDENT UPON KNOWLEDGE OF THEIR SURROUNDING ENVIRONMENT AND CONTRIBUTION OF THEIR DATA.
- TEAM MANAGEMENT TECHNIQUES OFFER AN EXPLOSIVE IMPACT ON PRODUCTIVITY
- TMT STRUCTURED METHODOLOGIES CHANNEL THIS ENERGY TOWARD "TOP DOWN" PLANNING GOALS

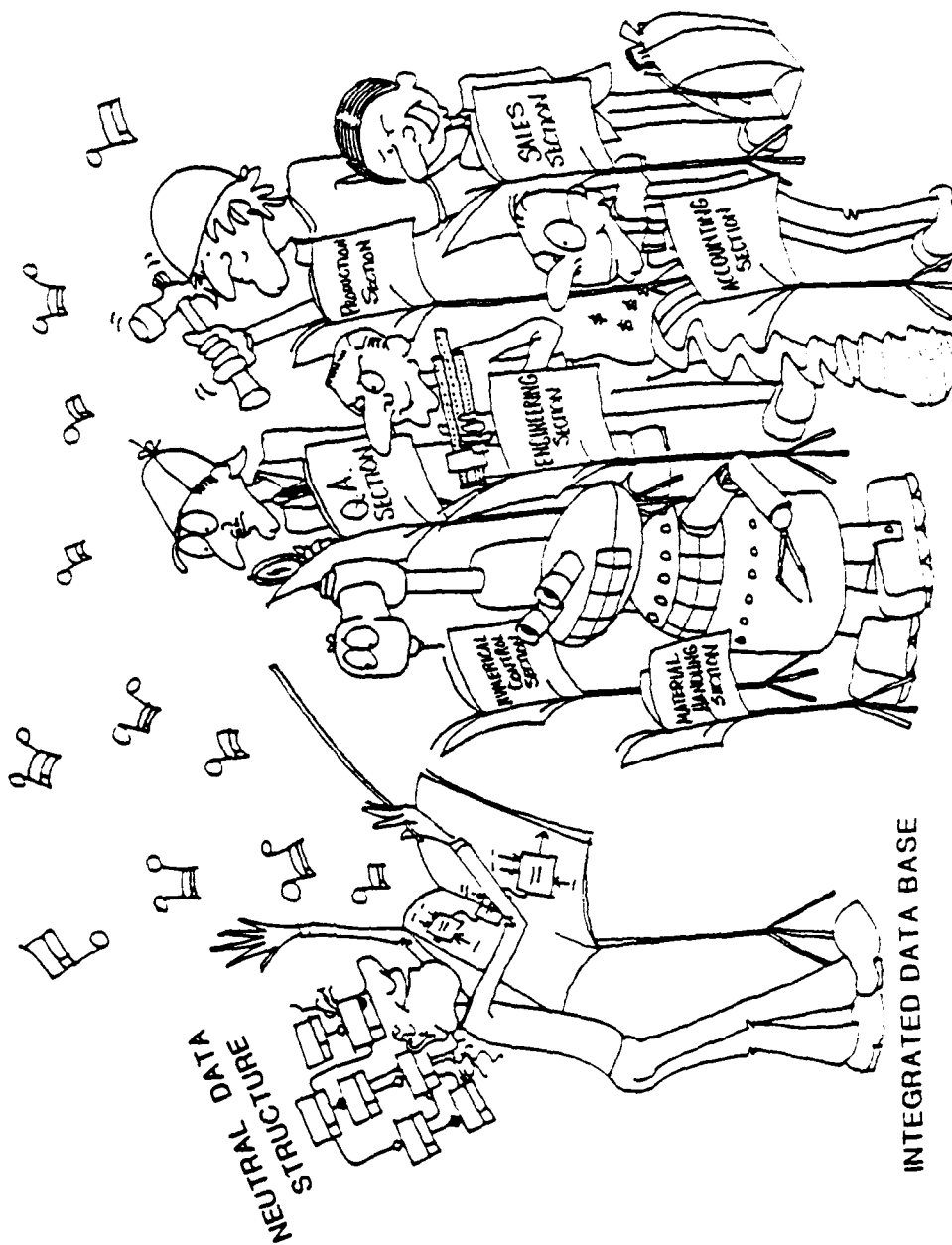
## TEAM MANAGEMENT TECHNIQUES (TMT)

---

- PROJECT DEFINITION
- ASSIGN PROJECT TEAMS
- SELECT TEAM MEMBERS
- MANAGE TEAM MEETINGS
- STRUCTURED ANALYTICAL INTEGRATION TOOLS
  - IDEF<sub>0</sub> FUNCTION/ACTIVITY MODELS
  - IDEF<sub>1</sub> INFORMATION MODELS
  - IDEF<sub>2</sub> DYNAMICS MODELS
  - COST DRIVER ANALYSIS (COST MODELS)
- ANTICIPATE FUTURE PROBLEMS

# INFORMATION RESOURCE MANAGEMENT (IRM)

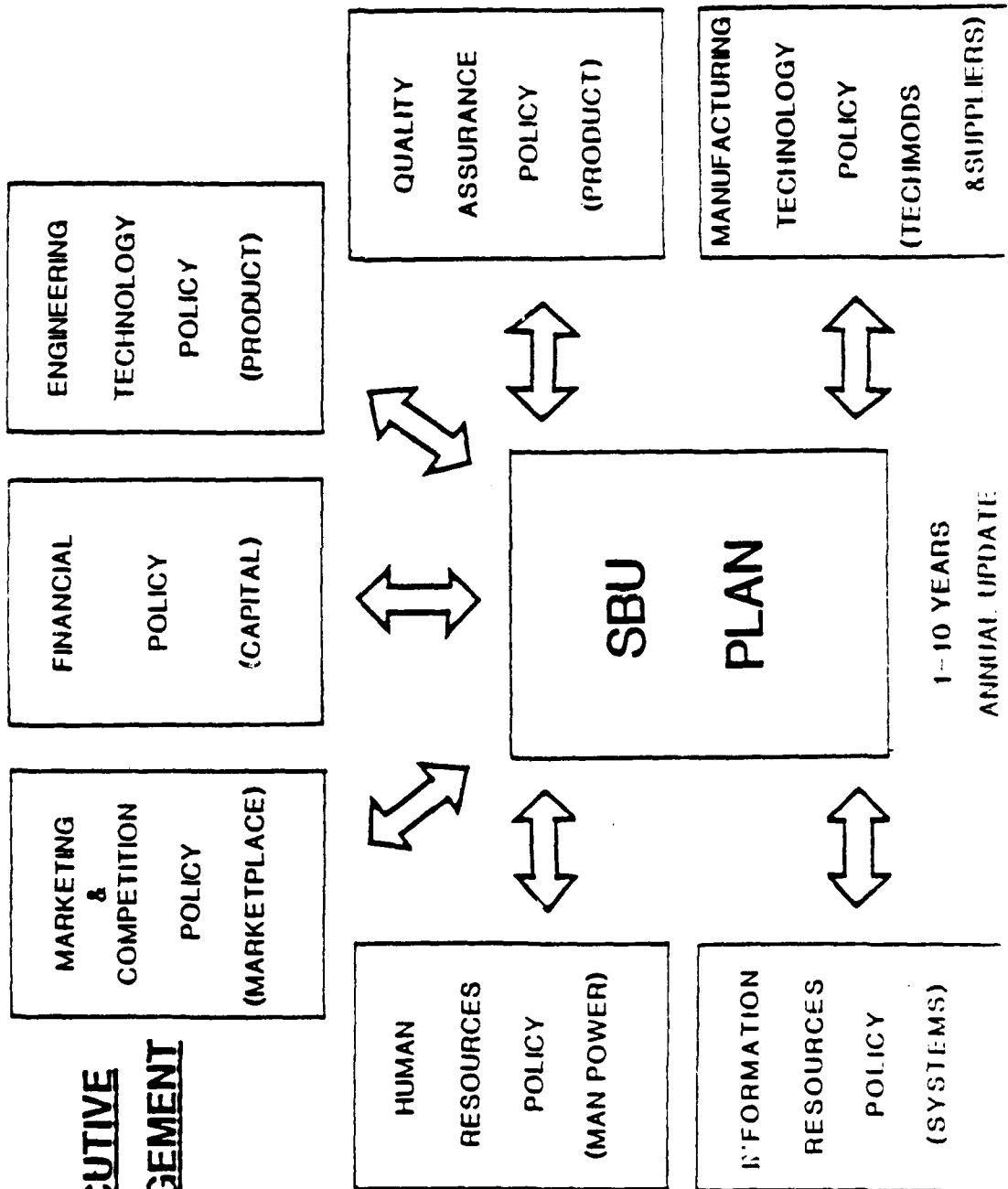
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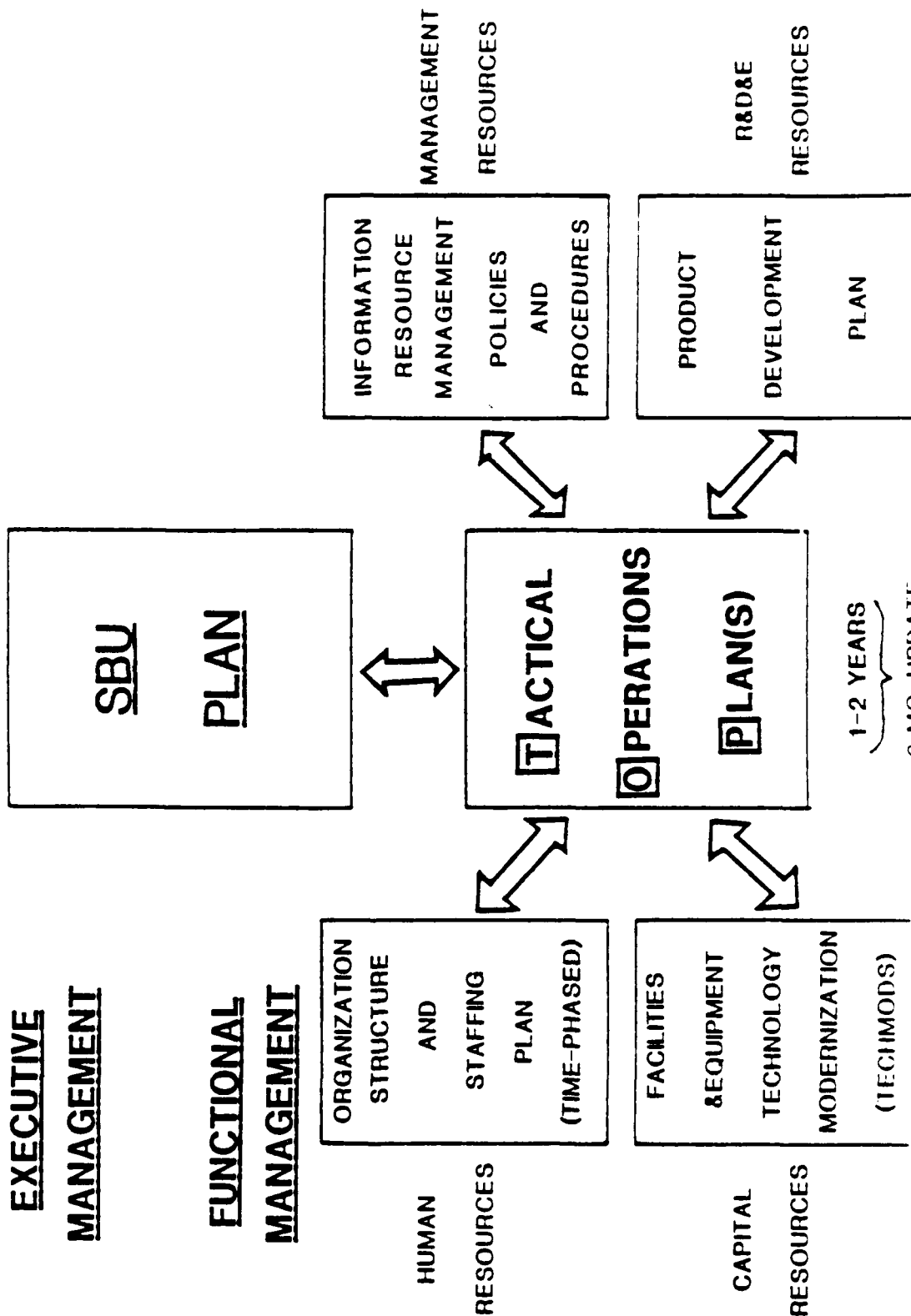
# **[S]TRATEGIC [B]USINESS [U]NIT PLAN**

## **EXECUTIVE MANAGEMENT**



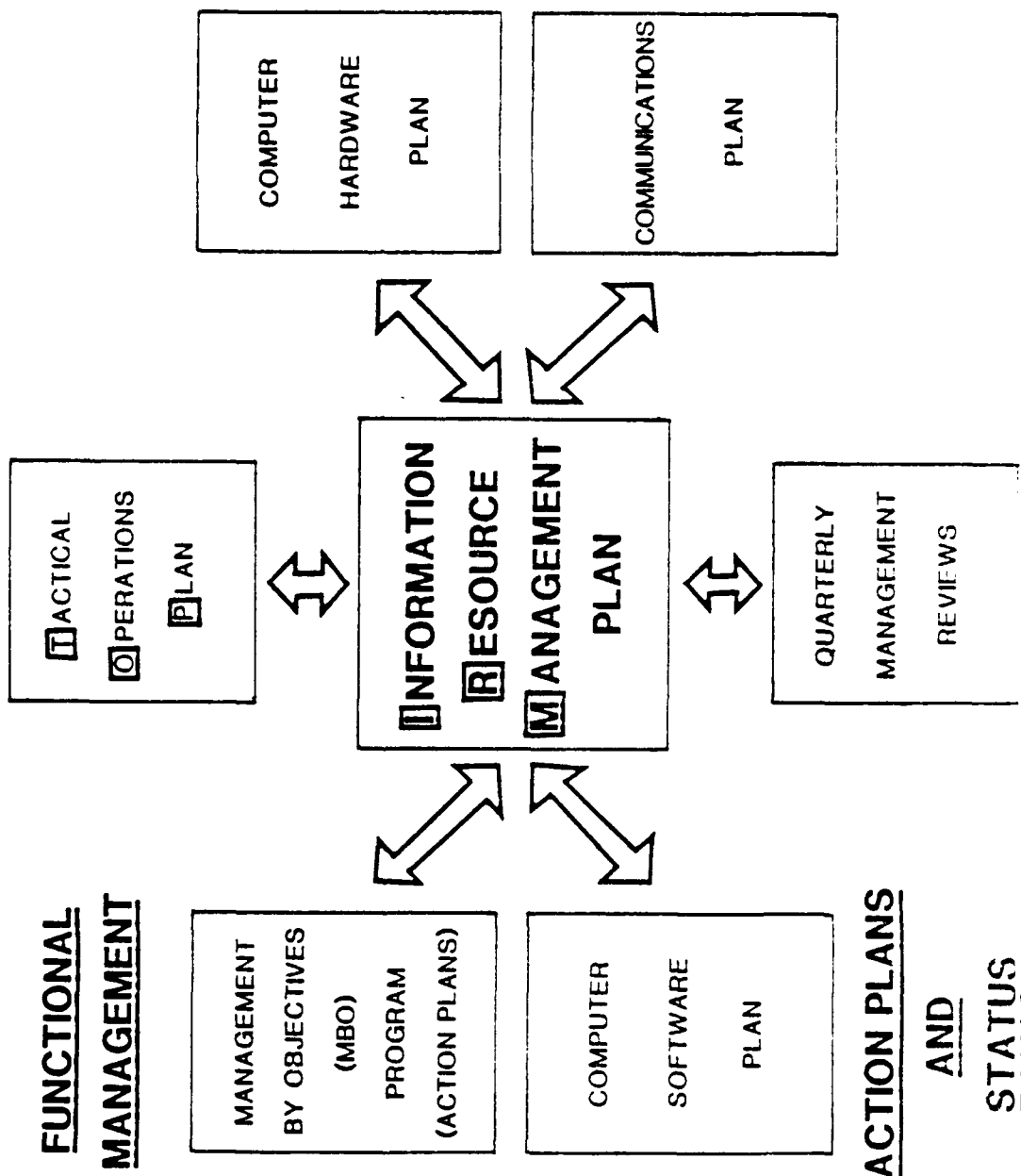
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8 September 1983

# TACTICAL OPERATIONS PLAN(S)



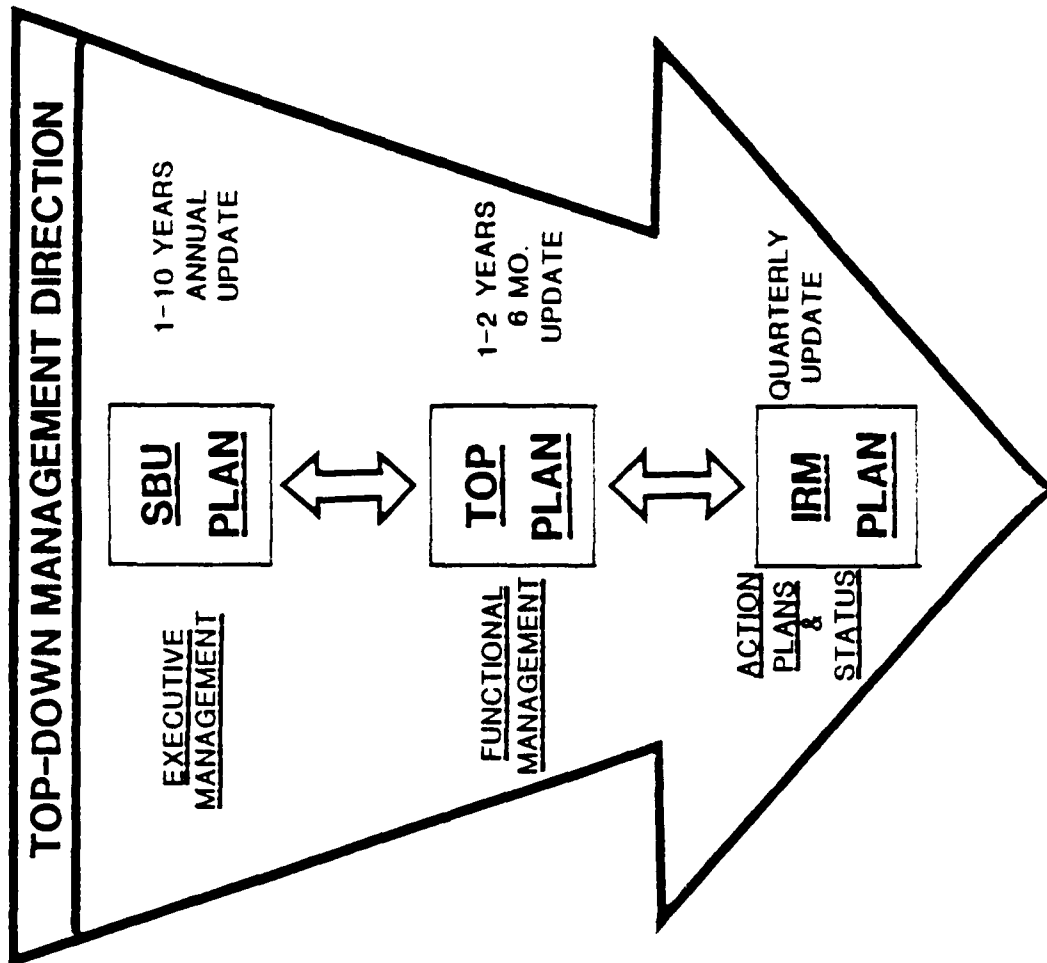
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8 September 1983

# INFORMATION RESOURCE MANAGEMENT PLAN

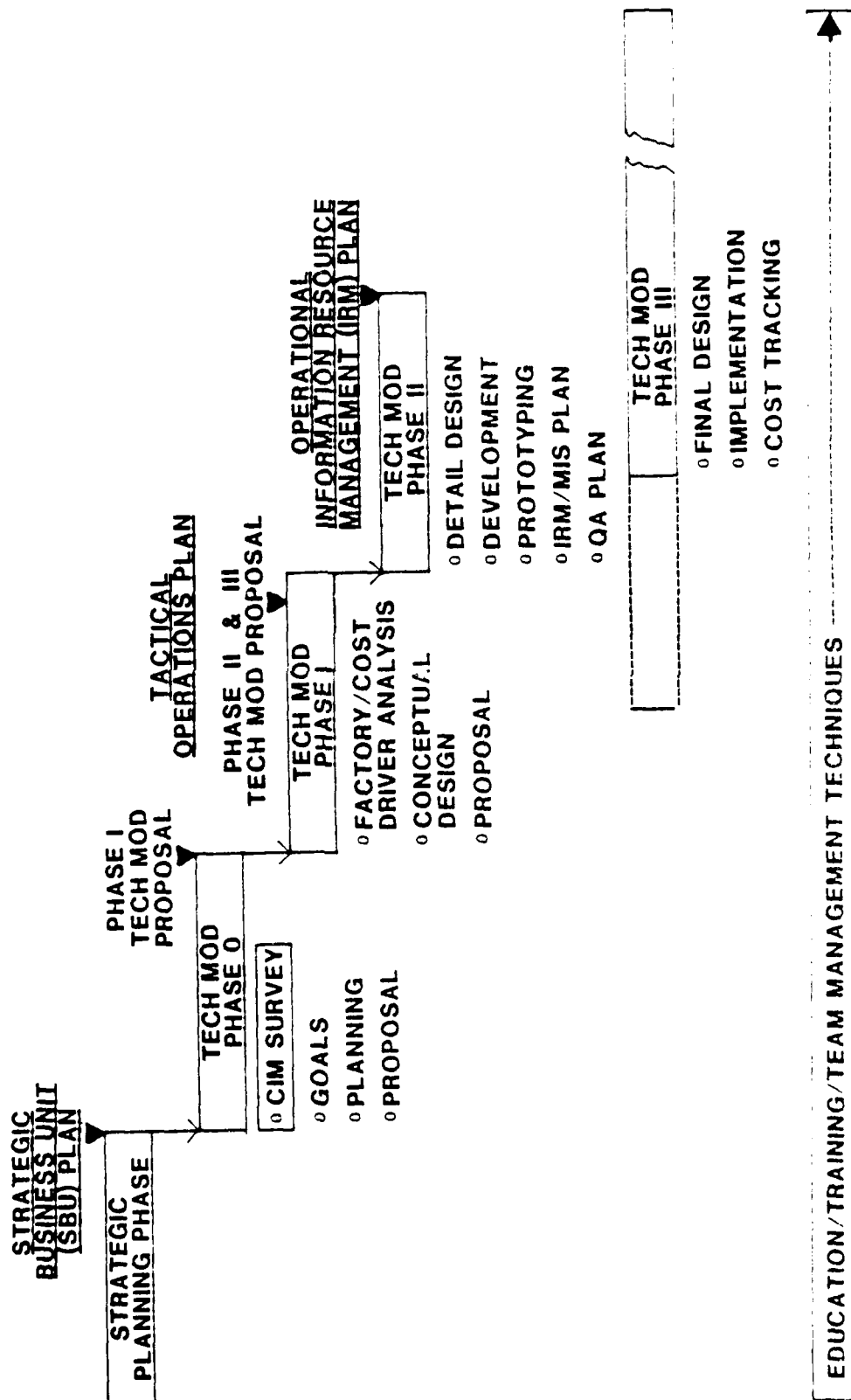


# INFORMATION RESOURCE MANAGEMENT PROGRAM

---

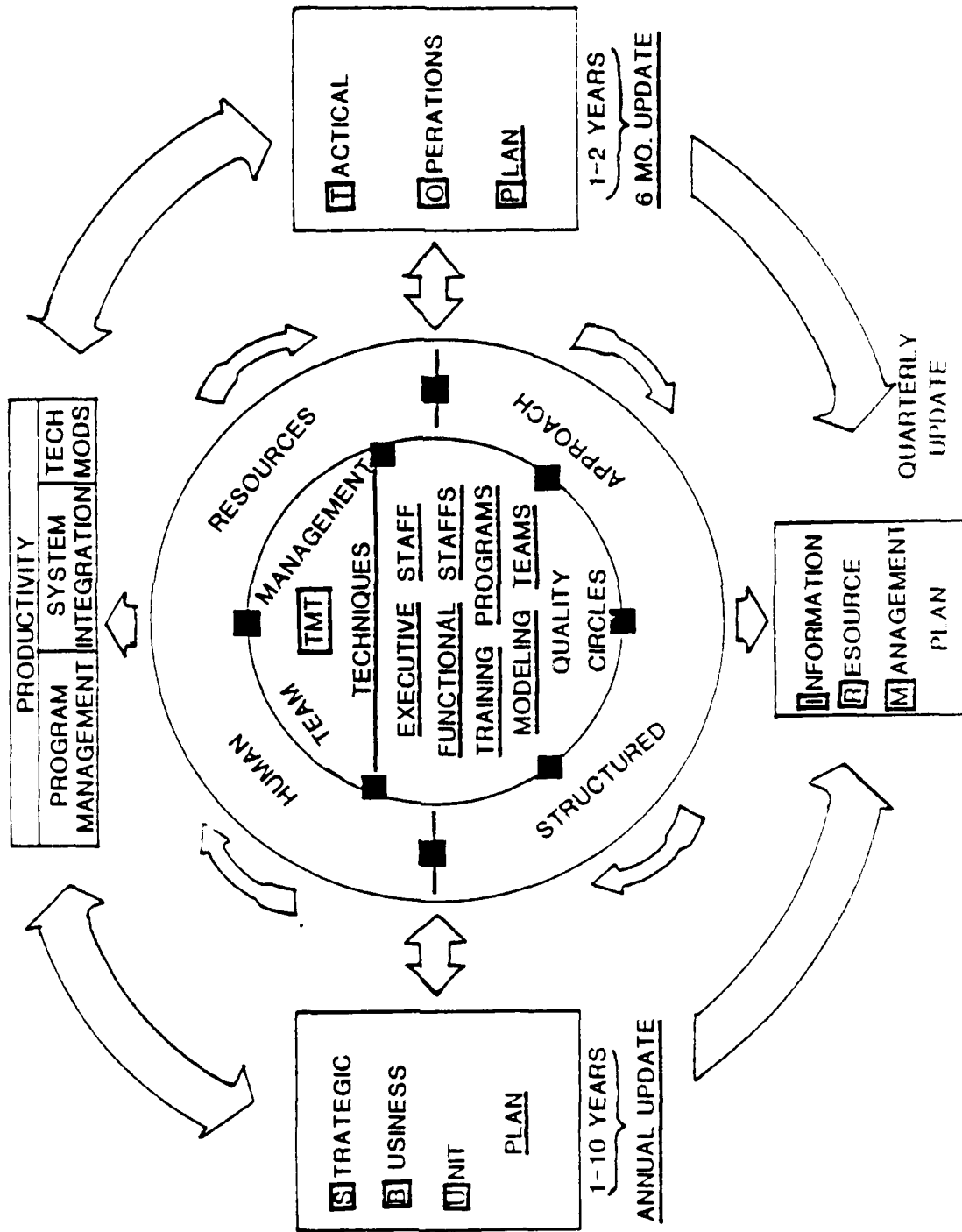


# TECHNOLOGY MODERNIZATION FRAMEWORK



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8 September 1983

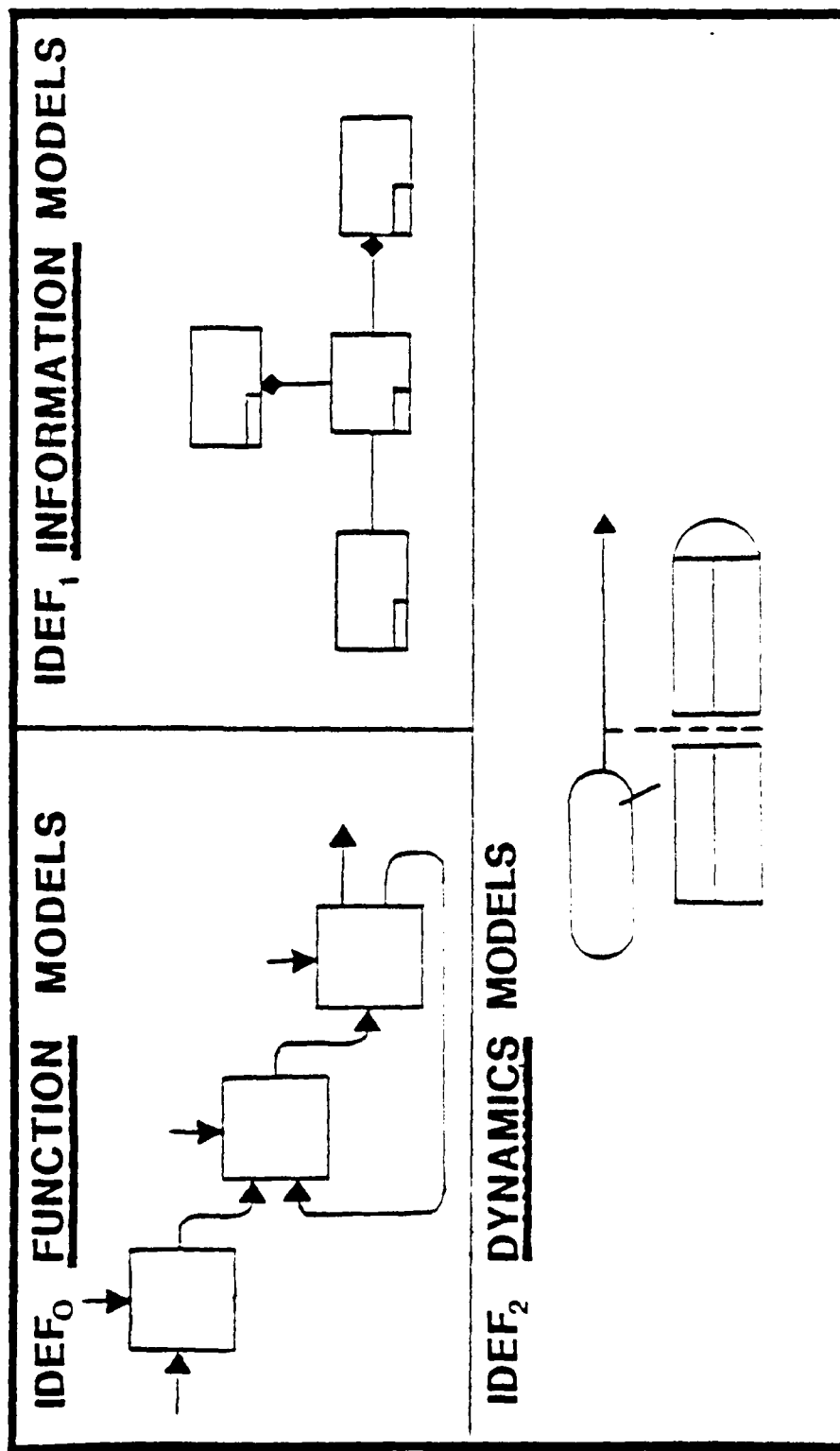
# IRM=" TOP-DOWN " PRODUCTIVITY ENGINEERING



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8 September 1983

# ICAM DEFINITION → IDEF

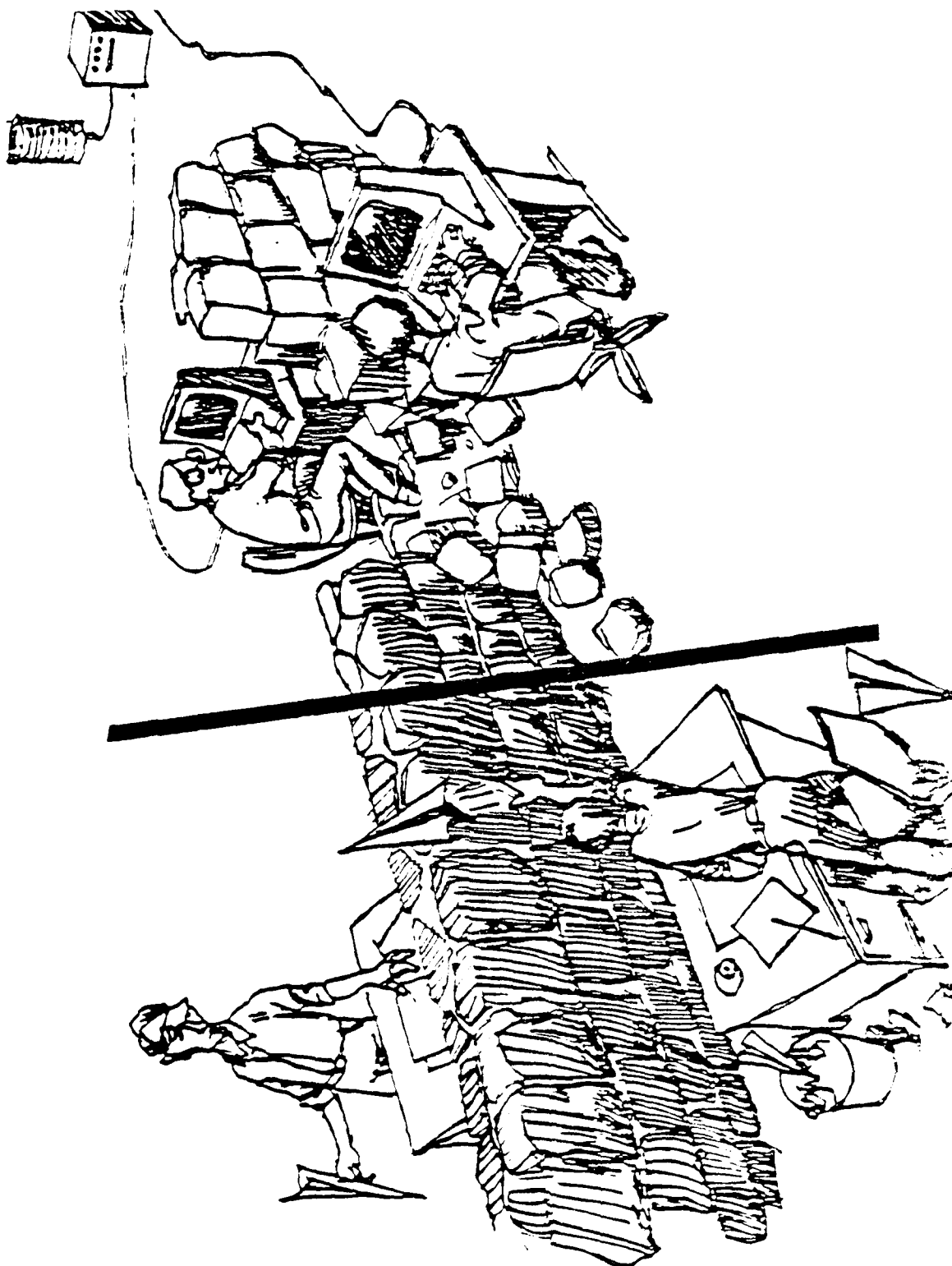
## SYSTEMATIC APPLICATION of COMPUTER TECHNOLOGY



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8 September 1983

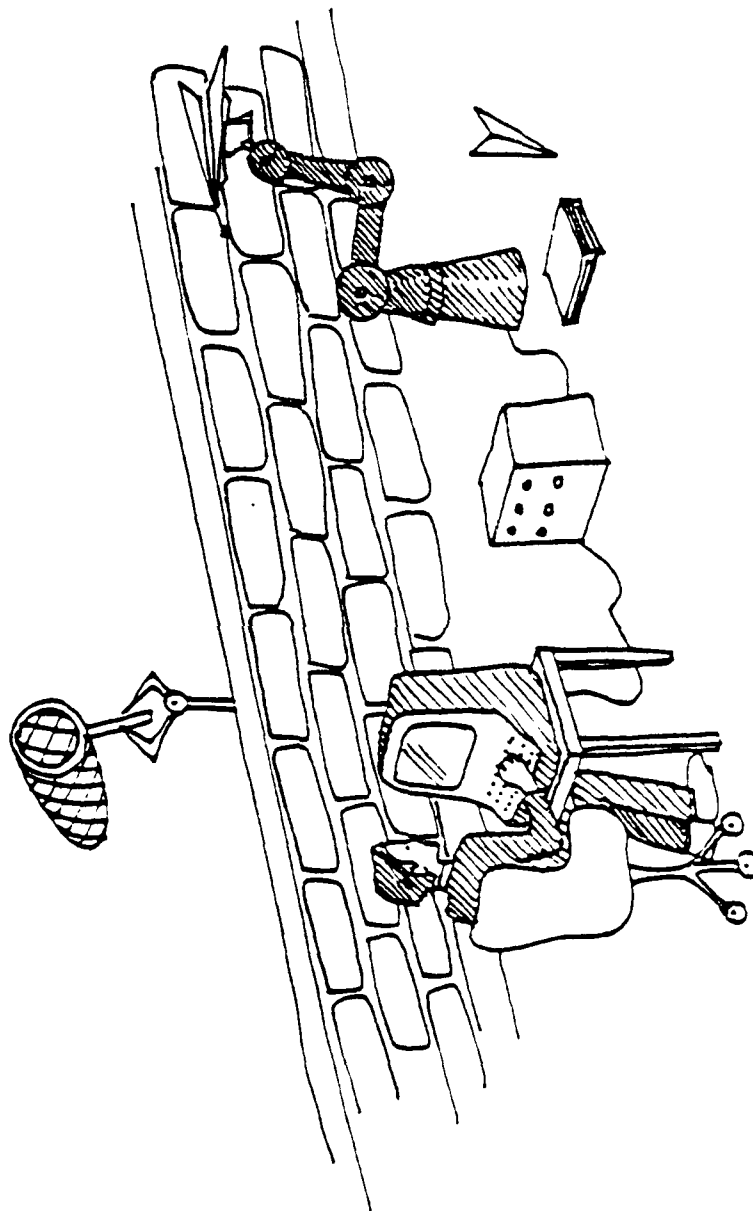
THE NEW WAY

THE OLD WAY





# THE WRONG WAY



# SUMMARY

---

- THE PROBLEM
  - U.S. PRODUCTIVITY PERFORMANCE
  - U.S. INDUSTRY AUTOMATION TECHNOLOGY
- THE SOLUTION
  - INTEGRATED COMPUTER AIDED  
MANUFACTURING/TECH MODS
  - ICAM ANALYTICAL/PLANNING TOOLS
  - INTEGRATED STRATEGIC PLANNING &  
INFORMATION RESOURCE  
MANAGEMENT (IRM)

## 2.2 Technology Transfer Executive Overview "Train the Trainers" Manual

### FOREWORD

This instructor's "Train the Trainers" Manual is designed to help orient and educate executive level management relative to the need for a structured approach to implementing new manufacturing technology, thereby gaining productivity. It provides an overview of the U.S. Air Force's Manufacturing Technology Modernization (TECH MOD) Program's use of related IDEF applications, concepts, and procedures. It also covers the use of ICAM Architecture in planning and controlling these Manufacturing Technology Modernization Programs to upgrade the U.S. industrial base.

This "Train the Trainers" Manual, coupled with the accompanying Presentation Manual, is designed to give the instructor maximum efficiency in orienting executive level personnel. It employs a step-by-step, section-by-section process, dealing with "top-down" Manufacturing Technology Modernization planning and "bottom-up" project implementation concepts and procedures.

### 2.2.1 Introduction

This is an instructor's "Train the Trainers" Manual intended to aid those teaching an executive overview of the Air Force Manufacturing Technology Modernization (TECH MOD) Program's use of ICAM IDEF Modeling Methodologies. Coupled with the instructor's Executive Overview Presentation Manual, it provides the elements and an order of presentation needed in teaching. The developing of style is left to the individual instructor.

This instructor's "Train the Trainers" Manual consists of: a guide to set-up and preparation, a step-by-step text, containing the objectives and procedures to be covered, concepts, and a suggested narration (with which to start).

The course materials are presented in a standardized format. Each page is composed of a copy of the presentation material, the instructional objective that must be covered with that material, and a suggested narration that may be followed until individual styles can be developed.

Overall planning for and conducting of actual executive training sessions is almost as critical to accomplishing participant learning objectives as the course presentation material. Attention must be given to planning for presentation set-up, pre-presentation, presentation, and post-presentation activities.

2.2.1.1 Presentation Set-Up

2.2.1.1.1 Audio/Visual Equipment:

- a) Overhead vue foil projector
- b) 35mm projector (if slides are used)

2.2.1.1.2 Audio/Visual Aids:

- a) Overhead transparencies
- b) 35mm color transparencies (when slides are used)
- c) Training materials (handouts and/or manuals)

2.2.1.1.3 Room Set-up:

Everyone must be in hearing and seeing distance of the presentation.

REMEMBER: The best instructional program is no good if you can't hear and see it!

2.2.1.2 Pre-Presentation

- Review all training materials beforehand and be familiar with them.
- Make sure room, equipment, and materials are all in order and ready to go when you are.  
  
REMEMBER: Prior planning prevents poor performance!
- Set up audio/visual equipment.
- Get audio/visual aids ready for presentation.
  - a) Make sure all overhead transparencies are in their order of presentation.
  - b) Make sure all 35mm color transparencies (when slides are used) are in their order of presentation and that they are all placed in carousel right-reading, (a slide in backward or upside down can throw your whole presentation off kilter).
- Handout copies of presentation materials may be provided if warranted by advance coordination.

#### 2.2.1.3 Presentation

- Give introduction
  - a) Include purpose and viewpoint of presentation.
  - b) Set atmosphere conducive to learning.
- Go through training materials step-by-step.
- Use peer cross-referencing method to check for understanding.

##### PEER CROSS-REFERENCING METHOD

- a) Ask who understands the point you've just presented.
- b) Ask who isn't clear about it.
- c) Ask if anyone who understands the point can explain it to those who don't.

NOTE: If you don't get any takers, you must explain it over again, if possible, in different terms.

- REMEMBER:

Just because you've presented the material doesn't mean that everyone has understood it.

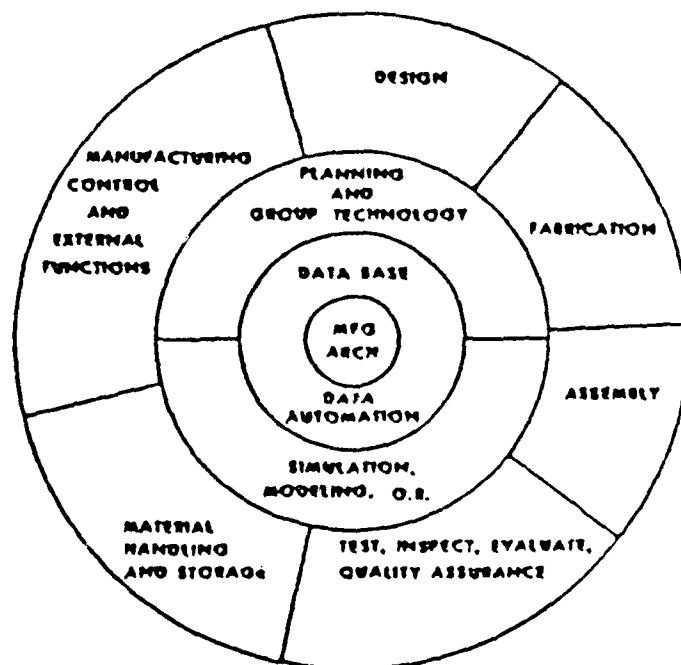
#### 2.2.1.4 Post Presentation

- Try not to leave any question unanswered. If you don't know, find out, and write or call with the answer.
- At some time, a sheet could be filled out with the name, organization, department, phone number, etc. of those attending. Get sheet typed and make copies to give to everyone. Use for:
  - historical record
  - contact sheet.

#### 2.2.2 A Structured Approach to Manufacturing Technology and Productivity

# USAF MANUFACTURING TECHNOLOGY PROGRAM

A MANUFACTURING TECHNOLOGY MODERNIZATION  
PROGRAM CONCEPT FOR  
INTEGRATED COMPUTER-AIDED MANUFACTURING (ICAM)  
IDEF/ARCHITECTURE METHODOLOGY



EXECUTIVE OVERVIEW "TRAIN THE TRAINERS" MANUAL

AD-A144 732

INTEGRATED COMPUTER-AIDED MANUFACTURING (ICAM)  
ARCHITECTURE PART 3 VOLUME (U) SOFTECH INC WALTHAM MA  
A W SNODGRASS SEP 83 1080-37

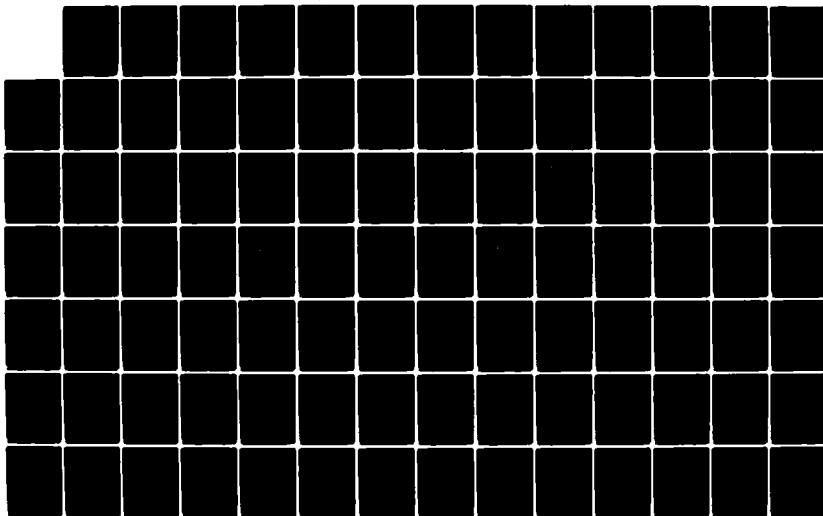
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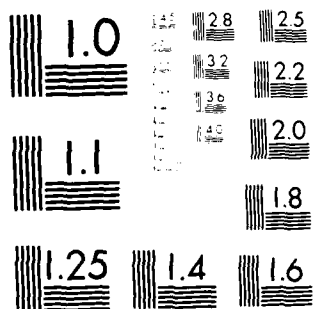
UNCLASSIFIED

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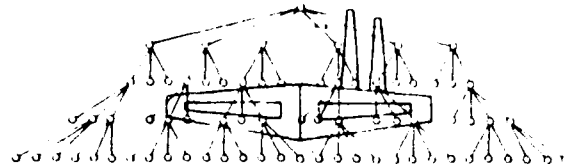


MICROCOPY RESOLUTION TEST CHART  
 NATIONAL BUREAU OF STANDARDS-1963-A



## EXECUTIVE OVERVIEW

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### A STRUCTURED APPROACH TO MANUFACTURING TECHNOLOGY AND PRODUCTIVITY

**TITLE SLIDE:**

Executive Overview - A structured Approach to Manufacturing Technology and Productivity.

**COURSE OBJECTIVE  
AND NARRATION:**

"THE PURPOSE OF THIS PRESENTATION IS TO ORIENT AND EDUCATE EXECUTIVE LEVEL MANAGEMENT RELATIVE TO THE NEED FOR A STRUCTURED APPROACH TO IMPLEMENTING NEW MANUFACTURING TECHNOLOGY, THEREBY GAINING PRODUCTIVITY. THIS OVERVIEW INCLUDES ANSWERS TO SUCH QUESTIONS AS:

- (1) WHY DO I WANT MY COMPANY TO LEARN ICAM IDEF?
- (2) HOW AM I GOING TO USE IT TO SOLVE MY PROBLEMS?
- (3) WHAT ARE THE BENEFITS OF USING ICAM IDEF?
- (4) WHAT OTHER COMPANIES HAVE USED IT AND HOW ARE THEY BENEFITING IN TERMS OF PRODUCTIVITY IMPROVEMENT?

## INTRODUCTION

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- THE PROBLEM
  - U.S. PRODUCTIVITY PERFORMANCE
  - U.S. INDUSTRY AUTOMATION TECHNOLOGY
- THE SOLUTION
  - INTEGRATED COMPUTER AIDED MANUFACTURING/TECH MODS
  - ICAM ANALYTICAL/PLANNING TOOLS
  - INTEGRATED STRATEGIC PLANNING & INFORMATION RESOURCE MANAGEMENT (IRM)

INSTRUCTIONAL OBJECTIVE: Provide an introductory overview for the Executive Overview presentation. (The flow of the overview material begins by conveying a summary of manufacturing problems as they are known to exist, followed by a summary of unintegrated automated manufacturing thrusts and other related efforts.)

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NARRATION: "THE UNITED STATES HAS EXPERIENCED A DECLINE IN THE RATE OF PRODUCTIVITY INCREASE RELATIVE TO THE REST OF THE INDUSTRIAL NATIONS. THE HIGH RATE OF INFLATION, SOCIAL TRENDS, GOVERNMENT REGULATIONS, LACK OF CAPITAL IMPROVEMENT INCENTIVES AND THE LOW PRIORITY GIVEN TO MANUFACTURING RESEARCH AND DEVELOPMENT HAVE COMBINED TO SERIOUSLY REDUCE THE CAPABILITY OF U.S. INDUSTRY TO COMPETE IN THE INTERNATIONAL MARKETPLACE.

"SIMULTANEOUSLY, SIGNIFICANT ADVANCES HAVE BEEN MADE IN U.S. INDUSTRY AUTOMATION TECHNOLOGY AVAILABLE SUCH AS COMPUTER-AIDED DESIGN (CAD) SYSTEMS, ROBOTICS, MICRO-PROCESSORS AND MINICOMPUTERS, DNC/CNC/NC CONTROL SYSTEMS, AND TELECOMMUNICATIONS AND OFFICE AUTOMATION. WE HAVE NOT YET LEARNED TO IMPLEMENT THIS NEW TECHNOLOGY EFFECTIVELY ON AN INTEGRATED BASIS TO PROVIDE MAXIMUM PRODUCTIVITY IMPACT.

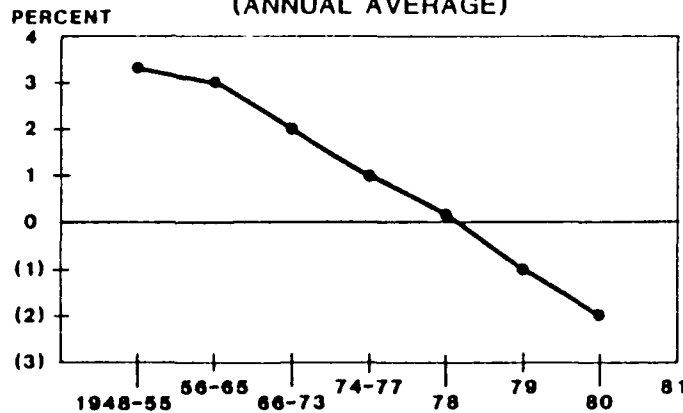
"WE BELIEVE THE SOLUTION TO THIS PROBLEM LIES IN INTEGRATED COMPUTER-AIDED MANUFACTURING AND MANUFACTURING TECHNOLOGY MODERNIZATION. (MANUFACTURING TECHNOLOGY MODERNIZATION MAY BE REFERRED TO HEREAFTER AS "TECH MODS" WHETHER OR NOT THE COMPANY EFFORT IS CONTRACTUALLY COMMITTED TO A MILITARY CUSTOMER OR STRICTLY AN IN-HOUSE COMPANY PROGRAM.)

"THE U.S. AIR FORCE INTEGRATED COMPUTER-AIDED MANUFACTURING PROGRAM (ICAM) HAS DEVELOPED ANALYTICAL AND PLANNING TOOLS TO ASSIST BOTH THE GOVERNMENT AND INDUSTRY IN ACCOMPLISHING COMPUTER-INTEGRATED MANUFACTURING (CIM). WE WILL DISCUSS THESE TOOLS FROM AN OVERVIEW PERSPECTIVE.

"WE RECOGNIZE THAT TECH MOD PROGRAMS MUST EMANATE FROM THE COMPANY'S OVERALL LONG-RANGE STRATEGIC BUSINESS PLAN IN SUPPORT OF PREDETERMINED COMPANY OBJECTIVES. WE WILL ALSO DISCUSS A POTENTIAL METHODOLOGY FOR INTEGRATING YOUR STRATEGIC PLANNING WITH INFORMATION RESOURCE MANAGEMENT UTILIZING THE ICAM ANALYTICAL AND PLANNING TOOLS."

## THE PROBLEM

### PRODUCTIVITY GROWTH RATE IN U.S. (ANNUAL AVERAGE)



SOURCE U.S. DEPARTMENT OF COMMERCE

INSTRUCTIONAL OBJECTIVE: To provide an understanding of the declining U.S. productivity growth rate.

NARRATION: "INCREASED PRODUCTIVITY IS THE CORNERSTONE OF THE ICAM PROGRAM. NUMEROUS STUDIES HAVE IDENTIFIED THE DECREASE IN PRODUCTIVITY IN AMERICAN INDUSTRY. WHILE U.S. INFLATION RANGED FROM 2% TO 12% DURING THE YEARS OF 1950 - 1980, PRODUCTIVITY GROWTH DECLINED AS SHOWN ON AN ANNUAL AVERAGE BASIS. THE U.S. RANKS LOWEST AMONG THE MILITARY POWERS OF THE WESTERN WORLD IN BOTH PRODUCTIVITY AND INVESTMENT AS A PERCENT OF GROSS NATIONAL PRODUCT. THE MESSAGE IS LOUD AND CLEAR. U.S. INDUSTRY SUPPORTING DEFENSE READINESS IS DECLINING IN PRODUCTIVITY."

## EXTERNAL ENVIRONMENT "CAUSES"

- SOCIAL TRENDS
- HIGH INFLATION RATE
- GOVERNMENT REGULATIONS
- R&D LOW PRIORITY
- LACK OF CAPITAL IMPROVEMENT  
INCENTIVES

INSTRUCTIONAL OBJECTIVE: To discuss external environment  
"causes" for U.S. productivity decline.

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NARRATION: "WE ALL RECOGNIZE THAT THERE HAVE BEEN SIGNIFICANT  
EXTERNAL ENVIRONMENT INFLUENCES ON U.S. INDUSTRY  
DURING THE PERIOD OF PRODUCTIVITY DECLINE WE JUST  
DISCUSSED. WHILE WE DO NOT MINIMIZE THESE EXTERNAL  
CAUSES, WE MUST ALL COOPERATIVELY DO WHAT WE CAN TO  
COPE WITHIN OUR SURROUNDING ENVIRONMENT AND ATTACK  
THOSE AREAS WITHIN OUR OWN SPHERE OF INFLUENCE."

## DECLINING PRODUCTIVITY "SYMPTOMS"

- OVERHEAD AND INDIRECT RESPONSIBLE FOR  
60-70% OF PRODUCT COST
- AVERAGE MACHINE UTILIZATION LESS THAN 30%
- DIRECT FAB PROCESS ONLY 1 1/2% PART'S  
"SHOP LIFE"
- RISING LABOR COSTS BEING DIRECTLY PASSED  
ON TO CONSUMERS
- INCREASING SOCIAL PRESSURES

INSTRUCTIONAL OBJECTIVE: To focus attention on internal factory declining productivity "symptoms."

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NARRATION: "VARIOUS PUBLISHED STUDIES INDICATE THAT THERE IS MUCH THAT WE CAN DO TO ATTACK DECLINING PRODUCTIVITY BY FOCUSING ON "SYMPTOMS" SUCH AS THESE:

SOME ARE STILL CONVINCED THAT THE KEY TO IMPROVED PRODUCTIVITY SUCCESS LIES IN PARING DIRECT LABOR CONTENT OF OUR PRODUCTS TO REDUCE COSTS. MANY TOP MANAGERS ARE NOW WAKING UP TO THE FACT THAT PRODUCTIVITY IMPROVEMENT PROGRAMS MUST EXTEND BEYOND THE BLUE COLLAR WORKERS.

RECENT STUDIES INDICATE THAT U.S. INDUSTRY'S AVERAGE MACHINE UTILIZATION IS LESS THAN 30%. WE CANNOT AFFORD TO CONTINUE ON THIS PATH.

INVENTORY CARRYING COSTS SIGNIFICANTLY IMPACT OUR OVERALL PRODUCTIVITY. RECENT STUDIES HAVE SHOWN THAT MATERIAL MAY SPEND ONLY ONE AND ONE-HALF PERCENT OF ITS "SHOP LIFE" ACTUALLY BEING WORKED UPON BETWEEN THE RECEIVING DOCK AND THE END PRODUCT SHIPMENT.

UNTIL RECENTLY MANY U.S. COMPANIES HAVE BEEN ABLE TO PASS RISING LABOR COSTS DIRECTLY ON TO THEIR CONSUMERS THEREBY FUELING INFLATION. WE NO LONGER CAN TOLERATE THIS PASS THROUGH.

FTR110410000U  
8 September 1983

WE ARE ALL EXPERIENCING SOCIAL PRESSURES CREATED  
BY DEMOGRAPHIC CHANGES, EDUCATIONAL LEVELS, AND  
THE EXPECTATION LEVEL OF OUR U.S. SOCIETY.

ALL OF THESE FACTORS ARE SYMPTOMATIC OF OUR DECLINING  
PRODUCTIVITY BUT REPRESENT INTERNAL AREAS WHEREIN  
INDIVIDUAL U.S. COMPANIES CAN DEFINITELY HAVE AN  
IMPACT ON OVERALL U.S. PERFORMANCE."

## LOST PRODUCTIVITY

'AMERICAN WORKERS ACTUALLY ARE  
PRODUCING, ON AVERAGE, ONLY ABOUT 55%  
OF THE TIME THEY ARE ON THE JOB. THE  
RESULTING LOSS TOTALS 350 BILLION  
DOLLARS ANNUALLY.'

T. BARRY & ASSOCIATES

INDUSTRIAL ENGRG-NOV.'80

11-0

INSTRUCTIONAL OBJECTIVE: To focus executive management attention  
on the fact that the productivity  
problem only appears to be caused by  
direct touch labor personnel.

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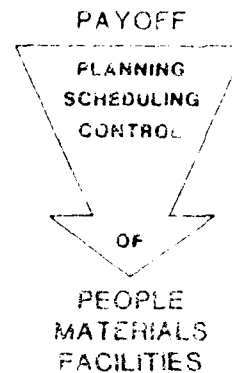
NARRATION: "AT FIRST GLANCE, THIS STATISTICAL STATEMENT BY  
THEODORE BARRY AND ASSOCIATES SEEMS TO SUPPORT THE  
BELIEF OF MANY THAT THE DECLINE IN U.S. PRODUCTIVITY  
IS CONTRIBUTABLE TO DIRECT TOUCH LABOR ON THE FACTORY  
FLOOR. WE MUST RECOGNIZE, HOWEVER, THAT PRODUCTIVITY  
IS NOT FOUND ONLY ON THE SHOP FLOOR. FROM THE DAYS  
OF FREDERICK W. TAYLOR, THROUGH MODERN INDUSTRIAL AND  
MANUFACTURING ENGINEERING, THE PRODUCTIVENESS OF  
FACTORY FLOOR LABOR HAS ACTUALLY BEEN IMPROVING. IT  
IS NOW TIME THE MANAGERS AND DESIGNERS OF THE FACTORY  
FOCUS ON OTHER AREAS; COMMUNICATION BETWEEN WORK  
CENTERS AND FACTORY MANAGEMENT, COMMUNICATION BETWEEN  
CENTERS, PRODUCT DESIGN, MATERIAL HANDLING, AND THE  
USE OF HUMAN AND INFORMATION RESOURCES."



## 45% OF DIRECT LABOR TIME IS NOT PRODUCTIVE

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- SOURCE
- 35% POOR SCHEDULING
  - 25% POOR INSTRUCTIONS
  - 15% INFLEXIBILITY
  - 25% POOR MATERIAL FLOW



INSTRUCTIONAL OBJECTIVE: To focus executive management attention on the fact that the productivity problem only appears to be caused by direct touch labor personnel.

NARRATION: "WHEN THE 45% OF DIRECT LABOR TIME THAT WAS NOT PRODUCTIVE WAS EXAMINED CLOSELY, IT WAS FOUND THAT THE PROBLEM SOURCE WAS NOT IN THE FACTORY LABOR ITSELF. IF WE EXAMINE THE SOURCE AS 100%, WE FIND THAT 35% OF THE PROBLEM WAS POOR SCHEDULING, 25% WAS EITHER POOR DESIGN OR WORK INSTRUCTION, 15% WAS LACK OF FLEXIBILITY OF THE PROCESS, AND 25% RESULTED FROM MATERIAL AVAILABILITY AND/OR POOR MATERIAL FLOW. TAKING THIS INTO CONSIDERATION, IT BECOMES CLEAR THAT PAYOFF ON THE FACTORY FLOOR IS IN THE AREA OF IMPROVED DESIGN, PROCESS PLANNING, SCHEDULING AND THE CONTROL OF PEOPLE, MATERIALS, AND FACILITIES.

"STUDIES OF THIS AREA BECOME EVEN MORE INTERESTING WHEN WE UNBURDEN THE DIRECT HOURLY FACTORY RATES AND PUSH THE COSTS BACK TO THE FUNCTION THAT ACTUALLY GENERATES THE COSTS. BY DEALING WITH THE UNBURDENED LABOR DOLLARS, WE CAN BEGIN TO IDENTIFY THE TRUE SOURCES OF COSTS (I.E. THE COST DRIVERS) AND IDENTIFY WHICH ARE MOST SENSITIVE TO IMPROVEMENTS. BY REDUCING THESE SOURCE COSTS, WE CAN REDUCE PRICE AND SIMULTANEOUSLY INCREASE PROFITABILITY FOR THE MANUFACTURING FIRM."

## U.S. INDUSTRY

### AUTOMATION TECHNOLOGY

INSTRUCTIONAL OBJECTIVE: To orient executive management to the potential problems inherent in unintegrated automated manufacturing thrusts.

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NARRATION: "THERE IS, HOWEVER, A POTENTIAL SOLUTION TO THIS INCREASINGLY SERIOUS PROBLEM OF PRODUCTIVITY PERFORMANCE. IT IS CALLED COMPUTER INTEGRATED MANUFACTURING (CIM). THE KEY INGREDIENTS REQUIRED TO IMPLEMENT A CIM SYSTEM ARE AVAILABLE AS EXISTING STATE-OF-THE-ART TECHNOLOGY, OR ARE CURRENTLY DEFINED AS ENABLING TECHNOLOGY IN THE MANUFACTURING AND COMPUTER INFORMATION SYSTEMS AREA. IN FACT, THERE IS PROBABLY AN OVERABUNDANCE OF UNUSED TECHNOLOGY AVAILABLE.

WE SEEM TO HAVE FAILED TO PUT PROPER EMPHASIS ON LONG-TERM SOLUTIONS TO PROBLEMS REGARDING PRODUCT COSTS AND DIRECT AND INDIRECT LABOR PRODUCTIVITY. TO LEND CREDENCE TO THIS PREMISE CONSIDER THIS; THE PHENOMENAL SUCCESS OF THE JAPANESE IN IMPROVING THEIR MANUFACTURING PRODUCTIVITY HAS BEEN ACHIEVED BY APPLYING MANUFACTURING AND COMPUTER INFORMATION SYSTEM TECHNOLOGY DEVELOPED ELSEWHERE - PRIMARILY IN THE U.S."

## U.S. INDUSTRY AUTOMATION TECHNOLOGY

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- AUTOMATION INVESTMENTS WILL TRIPLE TO \$5+BILLION BY 1985.
- CAD SYSTEMS WILL CLIMB +35% ANNUALLY TO ESTIMATED \$2.5 BILLION IN 1985 FROM \$610 MILLION IN 1979.
- MINICOMPUTERS, NUMERICAL CONTROLS AND PROGRAMMABLE CONTROLLERS WILL CLIMB +35% ANNUALLY TO \$2.3 BILLION IN 1985 FROM \$570 MILLION IN 1980.
- ROBOTS WILL JUMP TO 80,000 UNITS BY 1985 FROM 2,000 UNITS IN 1981 TO TOTAL OF \$+600 MILLION.

BUSINESS WEEK - 11 AUGUST 1983 - SPEED UP IN AUTOMATION

INSTRUCTIONAL OBJECTIVE: To develop an understanding that "islands of technology" will not necessarily solve the U.S. productivity problem.

NARRATION: "U.S. INDUSTRY IS BEGINNING TO SPEED UP ITS AUTOMATION BUT THERE IS AN INHERENT DANGER IN THE APPROACH BEING TAKEN BY MANY COMPANIES. THERE ARE TOO MANY NON-INTEGRATED MODULES BEING INSTALLED. TURNKEY SYSTEMS ARE PROLIFERATING. THEY ARE DISJOINTED AND IT MAY BE VERY COSTLY, IF NOT IMPOSSIBLE, TO TIE THEM TOGETHER IN THE FUTURE. IT COULD BE A BIG WASTE AND A NASTY SURPRISE.

"PLEASE NOTE THAT OUR U.S. AUTOMATION INVESTMENTS ARE NOW NOT ONLY BEING MADE ON THE FACTORY FLOOR, BUT ARE IMPACTING UPON OTHER AREAS SUCH AS THE DESIGN PROCESS."

## EXECUTIVE MANAGEMENT TAKING "TOP DOWN" ACTION

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- OFFICE AUTOMATION - 38 MILLION OF 50 MILLION WHITE COLLAR JOBS AFFECTED ( WITH 20 TO 30 MILLION BY 1990 ) AT 20% VALUE ADDED PER EMPLOYEE.
- FLEXIBLE MANUFACTURING SYSTEM ( FMS ) - USERS EXPERIENCING IMPROVED MACHINE TOOL UTILIZATION AS MUCH AS 45% AND DECREASING WORKERS BY 30%
- CAD CAM SYSTEMS - TO CUT MANUFACTURING LEADTIME BY 25% AND INCREASE PRODUCTIVITY AS MUCH AS FOURFOLD
- TOP EXECUTIVES - NOW FORCING SOLUTIONS IN ORDER TO REMAIN IN BUSINESS IN THE 1990's.
- DECISIONS - TO AUTOMATE ARE STARTING AT THE BOARD LEVEL AND MOVING DOWN.

BUSINESS WEEK - 3 AUG 1981 "THE SPEED UP IN AUTOMATION"

INSTRUCTIONAL OBJECTIVE: To develop an understanding that "islands of technology" will not necessarily solve the U.S. productivity problem.

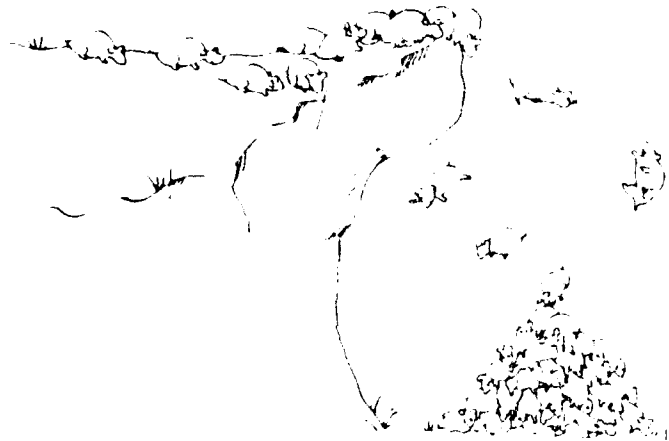
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NARRATION: "WE ARE ALSO WITNESSING A SIGNIFICANT TREND TOWARD AUTOMATING THE OFFICE AREAS OF U.S. INDUSTRY.

FLEXIBLE MANUFACTURING SYSTEMS, INCORPORATING SEVERAL MODULES OF TECHNOLOGY, ARE DEMONSTRATING SIGNIFICANT PRODUCTIVITY IMPROVEMENTS ON THE SHOP FLOOR.---IT IS INTERESTING TO NOTE THAT INSTRUCTIONS TO SUCH SYSTEMS MUST BE PRECISE AND ACCURATE BECAUSE THEY ARE ALL MADE EXPLICITLY BY THE COMPUTER TO ITS CONTROLLED MACHINERY.

WE LOOK FOR CAD/CAM SYSTEMS TO SIGNIFICANTLY IMPACT THE TIME SPAN REQUIRED TO DESIGN AND PRODUCE NEW OR UPDATED PRODUCTS.

CAUTION MUST BE EXERCISED, HOWEVER, TO AVOID UNSOUND AUTOMATION IMPLEMENTATION PROJECTS THAT ARE ONLY RESPONDING TO TOP-DOWN EXECUTIVE DIRECTION TO AUTOMATE. WE ALL KNOW WHAT THIS APPROACH RESULTED IN DURING THE INITIAL INTRODUCTION OF MORE ECONOMIC COMPUTING POWER IN THE 1960'S AND EARLY 1970'S."

## THE LEMMING APPROACH TO AUTOMATION



INSTRUCTIONAL OBJECTIVE: To develop an understanding that "islands of technology" will not necessarily solve the U.S. productivity problem.

NARRATION: "WE MUST BE CAREFUL THAT WE DO NOT DEVELOP AND/OR FOLLOW THE LEMMING APPROACH TO AUTOMATION.

"EACH COMPANY MUST CAREFULLY STUDY ITS STRATEGIC BUSINESS PLAN AND CUSTOMER COMMITMENTS, TO DEVELOP A WELL CONCEIVED MANUFACTURING TECHNOLOGY MODERNIZATION PROGRAM WHICH IS CUSTOM TAILORED TO ITS OWN NEEDS AND OBJECTIVES."

## TECHNOLOGY INTEGRATION

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- AN AVALANCHE OF UNCOORDINATED  
AUTOMATION TECHNOLOGY MODERNIZATION  
PROJECTS THREATENS TO BURY U.S. INDUSTRY

### UNLESS THERE IS

- TECHNOLOGY INTEGRATION

### SOMETIMES REFERRED TO AS

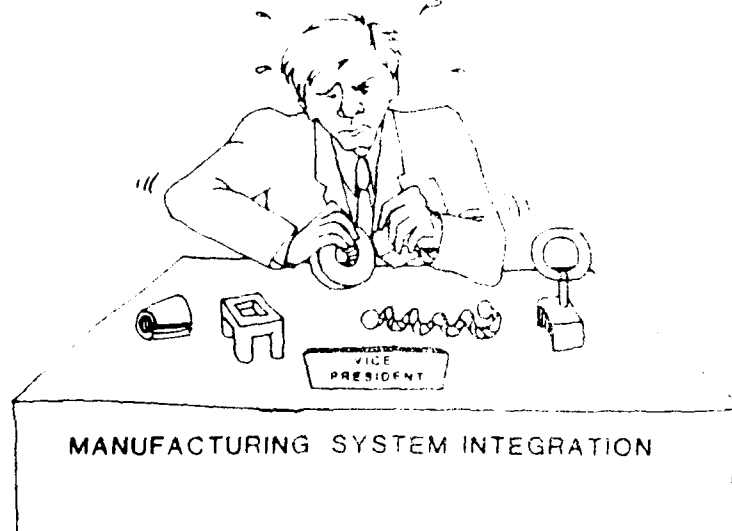
- COMPUTER INTEGRATED MANUFACTURING ( CIM )

INSTRUCTIONAL OBJECTIVE: To develop an understanding that  
"islands of technology" will not  
necessarily solve the U.S. productivity  
problem.

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NARRATION: "WE MUST EXERCISE CAUTION TO AVOID AN AVALANCHE OF  
UNCOORDINATED AUTOMATION TECHNOLOGY MODERNIZATION  
PROJECTS.

"WE MUST CAREFULLY PLAN AND CONTROL OUR TECH MOD  
PROGRAMS TO ENSURE THAT THERE IS TECHNOLOGY  
INTEGRATION, I.E. COMPUTER INTEGRATED MANUFACTURING  
(CIM)."

## COMPUTER INTEGRATED MANUFACTURING



INSTRUCTIONAL OBJECTIVE: To develop an understanding that "islands of technology" will not necessarily solve the U.S. productivity problem.

NARRATION: "SAD BUT TRUE, WE ALL HAVE EITHER EXPERIENCED OR KNOW THOSE THAT HAVE EXPERIENCED THIS FRUSTRATION.

"MANY EXECUTIVES THAT WE TALK TO ACROSS THE COUNTRY ADMIT THAT THE PERCENTAGE OF CAPITAL APPROPRIATION REQUESTS INVOLVING COMPUTERS HAS SIGNIFICANTLY MULTIPLIED THE LAST FEW YEARS. IT SEEMS WE CAN HARDLY UNDERTAKE A PROJECT ON THE FACTORY FLOOR, IN THE DESIGN AREA, OR IN THE ADMINISTRATIVE OFFICE THAT DOES NOT CONTAIN SOME FORM OF MICROPROCESSOR, MINICOMPUTER, OR MAIN-FRAME SUPPORT REQUIREMENT.

## COMPUTER INTEGRATED MANUFACTURING

- MANUFACTURING, WHICH BEGINS WITH PRODUCT DESIGN AND ENDS WITH SUPPORT AND MAINTENANCE IN THE FIELD, IS A MONOLITHIC, INDIVISIBLE FUNCTION. --- NO PART CAN BE SUCCESSFULLY CONSIDERED IN ISOLATION FROM ALL OTHER PARTS.
- DIVERSE AS THE VARIOUS PARTS OF MANUFACTURING MAY SEEM, THERE IS A COMMON THREAD THAT RUNS THROUGH THE FULL SCOPE OF ALL MANUFACTURING ACTIVITIES. -- MANUFACTURING IS, IN THE ULTIMATE ANALYSIS, A SERIES OF DATA PROCESSING OPERATIONS.

DR JOSEPH HARRINGTON  
1980 CAD/CAM CONFERENCE

INSTRUCTIONAL OBJECTIVE: To orient executive management to the need for a "top-down factory analysis" approach to manufacturing technology modernization.

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NARRATION: "WE MUST STEP BACK AND CONSIDER THESE TWO KEY POINTS MADE BY DR. JOSEPH HARRINGTON AT A 1980 CAD/CAM CONFERENCE:

NO PART OF THE MANUFACTURING ENTERPRISE CAN BE SUCCESSFULLY CONSIDERED IN ISOLATION OF ALL OTHER PARTS.

THE COMMON THREAD RUNNING THROUGH ALL OF THE MANUFACTURING ENTERPRISE IS A SERIES OF DATA PROCESSING OPERATIONS.---WE DO NOT NECESSARILY MEAN COMPUTER DATA PROCESSING, WE ARE DISCUSSING ALL DATA PROCESSING INCLUDING PENCILS, AND PAPER, TELECOMMUNICATIONS, CONVERSATIONS, AND COMPUTER DATA PROCESSING."



## SIGNIFICANT IMPACTS ON OUR HUMAN RESOURCES

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- SHORT PRODUCTION RUNS NOW ACCOUNT FOR 75% U.S. MANUFACTURING
- CAD/CAM AFFORDABLE FOR SMALL JOB SHOPS WITHIN DECADE
- CHANGES WILL AFFECT 45 MILLION JOBS IN U.S. NEXT 20 YEARS
- ONLY 13,000 CANDIDATES AVAILABLE IN 1981 TO FILL 29,000 ELECTRICAL AND COMPUTER SOFTWARE ENGINEERING SLOTS (BY 1985 SUPPLY WILL BE 15,000 VS. 51,000 DEMAND)

BUSINESS WEEK - TRAINING FOR THE CHANGING MANUFACTURING ENVIRONMENT

INSTRUCTIONAL OBJECTIVE: To orient management relative to external factors that will affect their human resources.

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NARRATION: "WE MUST ALSO REALIZE THAT THIS RAPIDLY CHANGING ENVIRONMENT WILL IMPACT HOW WE CONDUCT OUR BUSINESS WITH THE OUTSIDE WORLD IN THE FUTURE.

"MOST OF US HAVE LEARNED THAT SHORT BATCH PRODUCTION RUNS NOW ACCOUNT FOR 75% OF ALL U.S. MANUFACTURING. WE NO LONGER HAVE THE COMFORT OF LONG-TERM PRODUCTION PROCESS RUNS TO DEPEND UPON.

"CAD/CAM IS BECOMING AFFORDABLE FOR SMALL JOB SHOPS AND IT MAY BE VERY DIFFICULT FOR LARGE SLOW MOVING ORGANIZATIONS TO COMPETE WITH THE FLEXIBILITY OF THESE SMALLER ORGANIZATIONS IN THE FUTURE.

"THE AUTOMATION CHANGES WE HAVE BEEN DISCUSSING WILL AFFECT IN SOME WAY A MINIMUM OF 45 MILLION JOBS IN THE U.S. IN THE NEXT TWENTY YEARS IN SOME WAY.

"AT THE SAME TIME WE ARE FACED WITH DISLOCATION AND RETRAINING OF OUR HUMAN RESOURCE SKILLS, WE MUST ALSO LEARN TO COPE WITH A SHORTAGE OF PERSONNEL IN THE AREAS THAT AUTOMATION IS AFFECTING. WE MAY ONLY BE ABLE TO SUPPLY A PERCENTAGE OF THE TECHNICAL TALENT REQUIRED USING PRESENT PROGRAM DEVELOPMENT AND MAINTENANCE METHODS. IT IS PAINFULLY OBVIOUS MORE CAREFUL PLANNING AND NEW APPROACHES MUST BE TAKEN IN ORDER TO COPE."

## U.S. INDUSTRY AUTOMATION TECHNOLOGY

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- NO OTHER COUNTRY MATCHES U.S. IN COMPUTER SOFTWARE AND COMPUTER AIDED DESIGN.
- 90% OF JAPAN'S CAD SYSTEMS IMPORTED FROM U.S. - \$100 MILLION IN 1980 AND RISING.
- COMPUTER POWER COST DECREASING AVERAGE 50% EVERY 2 1/2 YEARS SINCE 1970.
- SOFTWARE DEVELOPMENT NOW PACING FACTORY AUTOMATION:
  - STANDARD GEOMETRIC SHAPE DEFINITION
  - INTEGRATED DATA BASES
  - COMMUNICATION PROTOCOLS
  - INFORMATION RESOURCE MANAGEMENT

BUSINESS WEEK 3 AUG 1981 "THE SPEED UP IN AUTOMATION"

INSTRUCTIONAL OBJECTIVE: To orient executive management relative to U.S. potential leadership areas.

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NARRATION: "ALL IS NOT GLOOM AND DOOM. TODAY NO OTHER COUNTRY MATCHES THE U.S. IN COMPUTER SOFTWARE AND COMPUTER-AIDED DESIGN .

"IN 1980, 90 PERCENT OF JAPAN'S CAD SYSTEMS WERE IMPORTED FROM THE U.S. WE MUST NOTE, HOWEVER, THAT JAPAN PROCURED \$100 MILLION WORTH OF CAD SYSTEMS IN 1980 AND THAT EXPENDITURE LEVEL IS RISING.

"COMPUTER POWER COST HAS DECREASED FIFTY PERCENT EVERY TWO AND HALF YEARS IN THE U.S. SINCE 1970. FOR EXAMPLE, IBM MEMORY COST HAS DROPPED FROM \$600,000 PER MEGABYTE (MILLION CHARACTERS) TO A LEVEL OF \$25,000 PER MEGABYTE IN 1980.

"SOFTWARE DEVELOPMENT IS NOW PACING FACTORY AUTOMATION AND INTEGRATION. WORK REMAINS TO BE ACCOMPLISHED IN THE AREAS OF STANDARD GEOMETRIC SHAPE DEFINITION, INTEGRATED DATABASES, COMMUNICATIONS PROTOCOL, AND THE OVERALL SUBJECT OF INFORMATION RESOURCE MANAGEMENT.

"WE STILL HAVE THE POTENTIAL, IF WE RAPIDLY EXPLOIT U.S. INDUSTRY'S AUTOMATION TECHNOLOGY LEAD, TO REGAIN AND/OR MAINTAIN OUR WORLDWIDE LEADERSHIP POSITION IN THE AREAS OF BOTH DEFENSE READINESS AND ECONOMIC COMPETITIVENESS."

**I** NTEGRATED  
**C** OMPUTER **A** IDED **M** ANUFACTURING  
(ICAM)  
PROGRAM

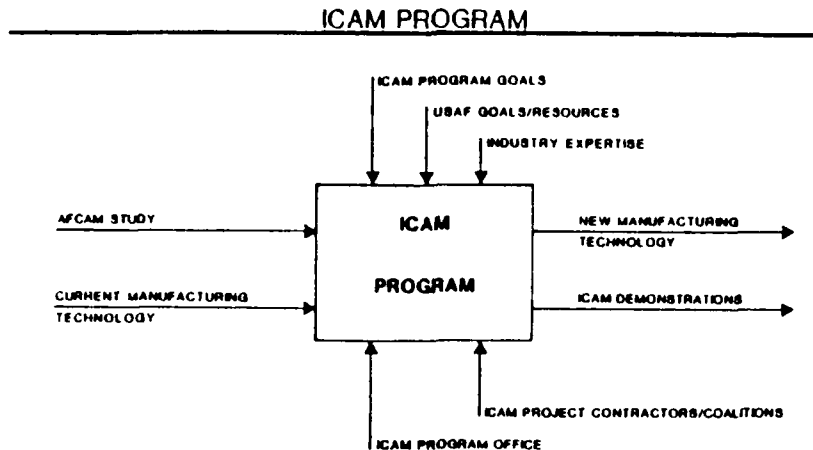
INSTRUCTIONAL OBJECTIVE: To introduce the U.S. Air Force Integrated Computer-Aided Manufacturing (ICAM) Program and its contribution to potential productivity gains.

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NARRATION: "THUS FAR, WE HAVE DISCUSSED THE PRODUCTIVITY PERFORMANCE PROBLEM AND THE AUTOMATION TECHNOLOGY AVAILABLE TO U.S. INDUSTRY TO SOLVE SAME.

"WE HAVE ALSO SURMISED THAT UNINTEGRATED MANUFACTURING AUTOMATION THRUSTS COULD BE VERY EXPENSIVE AND ILL-ADVISED.

"LET'S NOW TAKE A LOOK AT THE U.S. AIR FORCE'S ICAM PROGRAM AND ITS POTENTIAL CONTRIBUTION TO THE SOLUTION OF THESE PROBLEMS."



70 - 8

INSTRUCTIONAL OBJECTIVE: To orient executive management relative to the ICAM Program.

NARRATION: "THE U.S. AIR FORCE ICAM PROGRAM WAS INITIATED IN 1977 FOLLOWING A JOINT AIR FORCE/INDUSTRY COMPUTER-AIDED MANUFACTURING STUDY. THE "FUNCTION" OF THE ICAM PROGRAM WAS TO UTILIZE THIS A.F. CAM STUDY AND CURRENT MANUFACTURING TECHNOLOGY AS "INPUTS." THE ICAM PROGRAM'S GOALS, COUPLED WITH U.S. AIR FORCE GOALS/RESOURCES AND INDUSTRY EXPERTISE, ARE THE "CONTROLS."

THE "MECHANISMS" THAT THE AIR FORCE HAS UTILIZED ON THE ICAM PROGRAM WERE THE ESTABLISHMENT OF AN ICAM PROGRAM OFFICE AT THE AIR FORCE MATERIAL LABORATORIES, COUPLED WITH ICAM PROJECT PRIME CONTRACTORS WITH SUPPORTING COALITIONS OF AEROSPACE COMPANIES, COMMERCIAL COMPANIES, ACADEMIA, AND OTHER GOVERNMENT AGENCIES.

THE "OUTPUT" OF THE ICAM PROGRAM HAS BEEN AND WILL CONTINUE TO BE NEW MANUFACTURING TECHNOLOGY WITH ACTUAL ICAM DEMONSTRATIONS."

FTD 247174 Doc  
9 September 1987

### ICAM PROGRAM OBJECTIVES

- REDUCE DEFENSE SYSTEM COSTS THROUGH CAM TECHNOLOGY
- ESTABLISH MEANS FOR INTEGRATED APPLICATION OF  
COMPUTER TECHNOLOGY
- IMPROVE LONG TERM COMPETENCE, EFFICIENCY AND  
RESPONSIVENESS TO DEFENSE NEEDS
- PROVIDE MECHANISM FOR ICAM TECHNOLOGY TRANSFER
- VALIDATE AND DEMONSTRATE COST SAVINGS & FLEXIBILITY  
OF ICAM METHODOLOGY

INSTRUCTIONAL OBJECTIVE: To orient executive management relative  
to ICAM Program objectives.

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NARRATION: "THE ICAM PROGRAM ESTABLISHED THESE FIVE OBJECTIVES  
EARLY IN THE PROGRAM."

(READ AND DISCUSS EACH OF THE FIVE OBJECTIVES)

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ICAM PROGRAM OBJECTIVES

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PRODUCTIVITY IMPROVEMENTS



COMPUTER TECHNOLOGY

AND

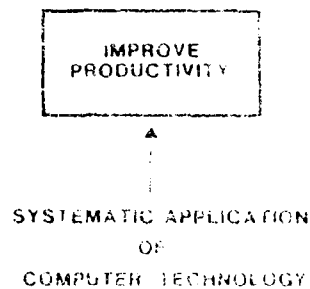
FACTORY MODERNIZATION

INSTRUCTIONAL OBJECTIVE: To summarize ICAM Program objectives  
for executive management.

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NARRATION: "IN SUMMARY, THE OBJECTIVE OF THE ICAM PROGRAM IS TO  
OBTAIN PRODUCTIVITY IMPROVEMENTS THROUGH THE  
SYSTEMATIC APPLICATION OF COMPUTER TECHNOLOGY AND  
FACTORY MODERNIZATION."

## PURPOSE OF ICAM



INSTRUCTIONAL OBJECTIVE: To orient executive level management to the ICAM life cycle, IDEF0 function modeling, and the purpose of ICAM.

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NARRATION: "THE PURPOSE OF THE ICAM PROGRAM IS TO IMPROVE PRODUCTIVITY. WHAT DISTINGUISHED THE ICAM GOAL FROM TRADITIONAL PRODUCTIVITY GOALS IS THAT THE ICAM PROGRAM RECOGNIZES THAT PRODUCTIVITY CAN BE IMPROVED NOT JUST THROUGH THE APPLICATION OF NEW TECHNOLOGY, BUT AS WELL THROUGH THE SUCCESSFUL INTEGRATION OF THAT TECHNOLOGY INTO EXISTING MANUFACTURING.

RECOGNIZING THAT MANUFACTURING IS A VERY COMPLEX ENVIRONMENT COMPRISED OF MANY PEOPLE, SYSTEMS, AND TECHNOLOGIES, THE MECHANISM WE RECOMMEND TO IMPROVE PRODUCTIVITY IS THE SYSTEMATIC APPLICATION OF COMPUTER TECHNOLOGY.

SYSTEMATIC APPLICATION OF COMPUTER TECHNOLOGY IS UTILIZING A STRUCTURED APPROACH TO PLANNING, ORGANIZING, CONTROLLING, AND COORDINATING THE DEVELOPMENT AND IMPLEMENTATION OF NEW TECHNOLOGY."

## ICAM APPROACH

COMMUNICATION AND ANALYSIS



IMPROVE  
PRODUCTIVITY



SYSTEMATIC APPLICATION  
OF  
COMPUTER TECHNOLOGY

INSTRUCTIONAL OBJECTIVE: To orient executive level management to the ICAM life cycle, IDEF0 function modeling, and the purpose of ICAM.

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NARRATION: "BECAUSE OF THE COMPLEXITIES OF MANUFACTURING, NO ONE PERSON COMPLETELY UNDERSTANDS HOW BEST TO IMPROVE MANUFACTURING PRODUCTIVITY.

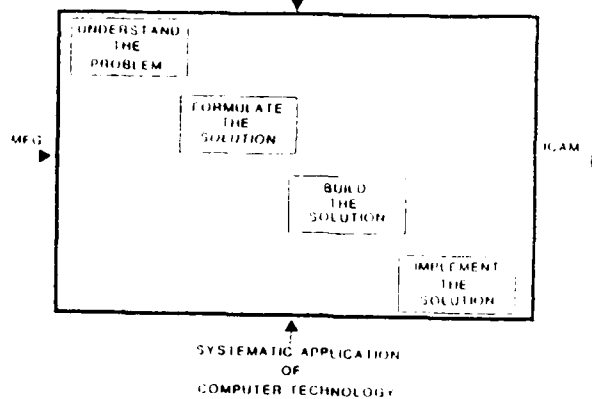
THERE IS A TREMENDOUS NEED TO BETTER UNDERSTAND, COMMUNICATE AND ANALYZE MANUFACTURING AND ITS COMPLEXITIES. TO IMPROVE PRODUCTIVITY, A COMMON UNDERSTANDING OF THE EXISTING MANUFACTURING PROBLEM AND THE FUTURE MANUFACTURING SOLUTION IS NECESSARY. THIS COMMON UNDERSTANDING MUST BE COMMUNICATED TO AND ANALYZED BY MANY DIFFERENT PEOPLE, RANGING FROM THE SHOP FLOOR USER, TO THE MANUFACTURING ANALYST, TO THE SYSTEM DEVELOPER, AND LAST BUT NOT LEAST, THE MANAGEMENT.

"THIS COMMUNICATION AND ANALYSIS APPROACH ACTS AS THE CONTROL IN OUR ICAM APPROACH."





## IMPROVE PRODUCTIVITY COMMUNICATION AND ANALYSIS



INSTRUCTIONAL OBJECTIVE: To orient executive level management to the ICAM life cycle, IDEFO function modeling, and the purpose of ICAM.

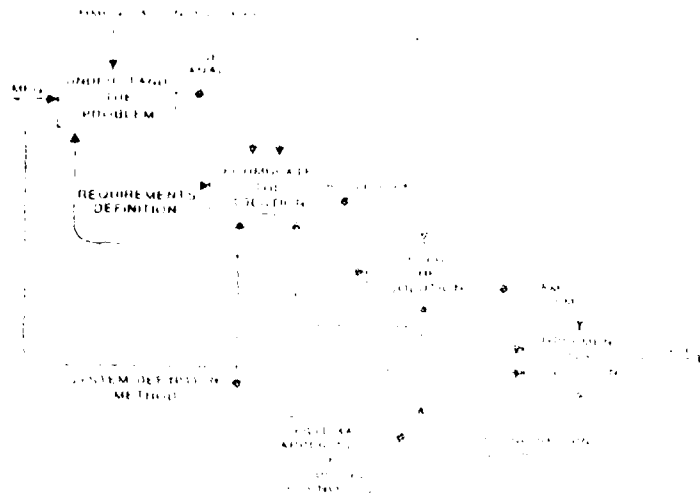
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NARRATION: "IF WE DECOMPOSE THE FUNCTION BOX WE HAVE BEEN DISCUSSING AND TAKE A DEEPER LOOK AT THE PROCESS OF IMPROVING MANUFACTURING PRODUCTIVITY, WE FIND FOUR BASIC STEPS THAT NEED TO BE TRAVERSED.

THESE STEPS FORM THE ICAM PROGRAM SYSTEM DEVELOPMENT LIFE CYCLE OF: 1) UNDERSTAND THE PROBLEM, 2) FORMULATE THE SOLUTION, 3) BUILD THE SOLUTION, AND 4) IMPLEMENT THE SOLUTION.

EACH STEP IS FUNDAMENTAL IN TRANSFORMING EXISTING MANUFACTURING INTO THE FUTURE INTEGRATED COMPUTER-AIDED MANUFACTURING ENVIRONMENT. THE ICAM PROGRAM SYSTEM DEVELOPMENT LIFE CYCLE IS SIMILAR TO OTHER SUCH LIFE CYCLES - BEGINNING WITH THE STATEMENT OF THE PROBLEM AND CULMINATING IN THE IMPLEMENTATION OF A SOLUTION."

## IMPROVE PRODUCTIVITY



INSTRUCTIONAL OBJECTIVE: To analyze and evaluate level management to the ICAM cycle, IDEF function modeling, and the purpose of ICAM.

NARRATION: "THE ICAM PROGRAM RECOGNIZED THAT THE TRADITIONAL PROBLEM STATEMENT IS TOTALLY INADEQUATE TO OBTAIN A COMPLETE UNDERSTANDING OF THE PROBLEM. WHO? BECAUSE THE TYPICAL PROBLEM STATEMENT MERELY IDENTIFIED SYMPTOMS OF PROBLEM OCCURRENCES. TO REALLY UNDERSTAND THE PROBLEM, WE NEED TO GO BEYOND THE SYMPTOMS.

WE NEED TO STUDY THE ENVIRONMENT WITHIN WHICH THE PROBLEM OCCURS. TO DETERMINE THE NEEDS OF THAT ENVIRONMENT, IF IT IS TO PERFORM AS IT SHOULD, AND TO DEFINE THE ENVIRONMENT IN A MANNER THAT WILL PERMIT AN IN-DEPTH UNDERSTANDING OF THE CHARACTERISTICS (FUNCTIONS, INFORMATION, AND DYNAMICS) WHICH ESTABLISH THE EXISTING ENVIRONMENT AND ITS PERFORMANCE.

TO ENABLE AN IN-DEPTH UNDERSTANDING OF THE ENVIRONMENT, THE ICAM PROGRAM ESTABLISHED A SYSTEM DEFINITION METHOD KNOWN AS THE ICAM DEFINITION IDEF METHOD. IDEF CAPTURES, IN A STRUCTURED REPRESENTATION, THE CHARACTERISTICS OF MANUFACTURING THAT WILL ENHANCE OUR UNDERSTANDING OF MANUFACTURING AND HOW TO IMPROVE IT.

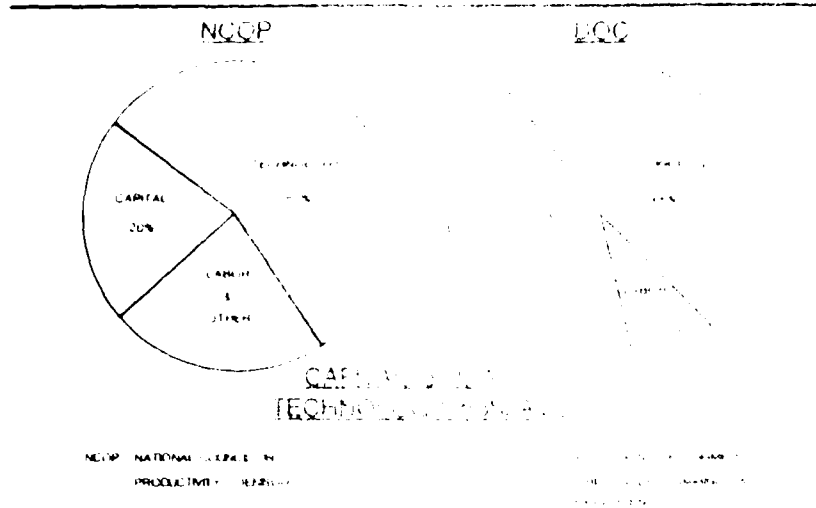
## **MANUFACTURING TECHNOLOGY MODERNIZATION PROGRAM (TECH MODS)**

INSTRUCTIONAL OBJECTIVE: To orient executive management to the need for, and the recommended approach to, a Manufacturing Technology Modernization (TECH MOD) Program.

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NARRATION: "BEFORE WE DISCUSS THE ICAM DEVELOPED ANALYTICAL AND PLANNING TOOLS IN MORE DETAIL, LET'S EXAMINE AND DISCUSS THE TECHNOLOGY MODERNIZATION FRAMEWORK WITHIN WHICH THEY CAN BE EFFECTIVELY APPLIED TO ASSIST YOU IN YOUR PRODUCTIVITY IMPROVEMENT EFFORTS."

CONTRIBUTIONS TO PRODUCTIVITY INCREASES



INSTRUCTIONAL OBJECTIVE: To compare and contrast management relative to the impact of technology modernization and capital expenditures of capital.

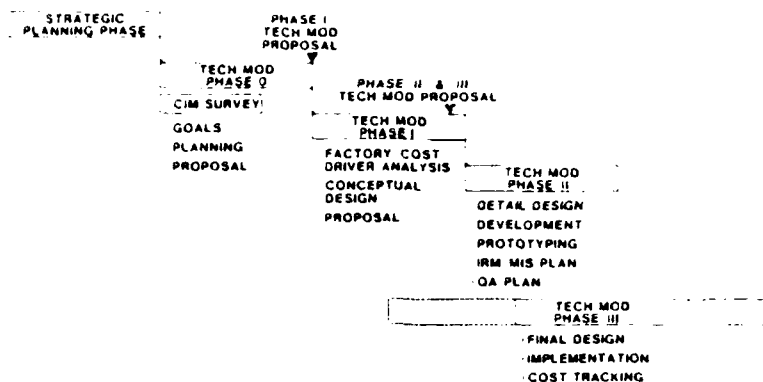
NARRATION: "THESE TWO NATIONAL STUDIES RELATIVE TO 'CONTRIBUTIONS TO PRODUCTIVITY INCREASES' DIFFER SOMEWHAT IN THEIR END RESULT PERCENTAGE ALLOCATIONS. THE NATIONAL COUNCIL ON PRODUCTIVITY (NCP) STUDY BY THE BROOKINGS INSTITUTE CONTRIBUTES OVER HALF OF ALL PRODUCTIVITY GAIN IN MANUFACTURING TO TECHNOLOGICAL INNOVATION AND, INTERESTINGLY ENOUGH, A THIRD OF THAT TO COMPUTING POWER ALONE.

"THE DEPARTMENT OF COMMERCE (DOC) STUDY CONTRIBUTED SOMEWHAT HEAVIER EMPHASIS TO CAPITAL EXPENDITURES.

OUR PURPOSE TODAY IS NOT TO ARGUE THE MERITS OF EITHER STUDY SO WE HAVE JUST AVERAGED THE STATISTICAL DATA TO SHOW A 53 PERCENT AVERAGE CONTRIBUTION BY TECHNOLOGY MODERNIZATION AND A 47 PERCENT AVERAGE CONTRIBUTION CONTRIBUTED TO CAPITAL EXPENDITURES

"ASSUMING THAT WE BELIEVE AND SUPPORT THESE STATISTICS, IT IS PAINFULLY CLEAR THAT WE MUST CHANGE COURSE IF WE ARE TO SOLVE THE U.S. PRODUCTIVITY PROBLEM."

## TECHNOLOGY MODERNIZATION FRAMEWORK



INSTRUCTIONAL OBJECTIVE: To provide executive management and understanding of a manufacturing technology modernization (TECH MOD) framework.

NARRATION: AS WE HAVE JUST DISCUSSED, TECHNOLOGY AND CAPITAL INVESTMENT ARE GENERALLY RECOGNIZED AS THE DOMINANT FACTORS IN PRODUCTIVITY GROWTH. THESE FACTORS ARE THE BASIS OF THIS PROGRAM'S NAME: "TECHNOLOGY" -- THE ESTABLISHMENT OF ADVANCED MANUFACTURING TECHNOLOGY, "MODERNIZATION" -- THE CAPITAL INVESTMENT REQUIRED TO IMPLEMENT ADVANCED MANUFACTURING TECHNOLOGY.

A MILITARY TECHNOLOGY MODERNIZATION (TECH MOD) PROGRAM COUPLES THE CONTRACTUAL TOOLS TO INCREASE CONTRACTOR CAPITAL INVESTMENT IN CONTEMPORARY AND ADVANCED TECHNOLOGY WITH MANUFACTURING STATE-OF-THE-ART ADVANCES SO THAT MAXIMUM PRODUCTIVITY ENHANCEMENT CAN BE ACHIEVED.

"THE AIR FORCE TECH MOD CONCEPT RESULTED FROM THE CONVICTION OF THE F16 PROGRAM MANAGER, MAJOR GENERAL JAMES ABRAHAMSON, THAT CAPITAL INVESTMENT COULD

REDUCED THE RISK OF FAILURE OF THE PROJECT AND THE  
POLICY PRESENTED BY THE COMPANY IN THE FIELD OF INVESTMENT

AND EQUIPMENT. THE COMPANY HAS BEEN ABLE TO REALIZE  
REALIZED GAINS IN THE FIELD OF INVESTMENT. THE  
THE COMPANY'S POLICY IN THE FIELD OF INVESTMENT  
MENTS DID NOT PRESENT A PROBLEM. THE COMPANY  
CAPITAL INVESTMENT IN THE FIELD OF INVESTMENT  
NEGOTIATION IN THE FIELD OF INVESTMENT. THE  
KEY MODIFICATIONS IN THE FIELD OF INVESTMENT  
INCLUDED: THE COMPANY HAS BEEN ABLE TO REALIZE  
SEPARATE CONTRACTS IN THE FIELD OF INVESTMENT  
TECHNOLOGY AND EQUIPMENT. THE COMPANY HAS  
\$100M IN SEVERAL YEARS. THE COMPANY HAS  
PROTECTION IN THE FIELD OF INVESTMENT. THE  
1158 AIRCRAFT. THE COMPANY HAS BEEN ABLE TO  
TRACT TARGET. THE COMPANY HAS BEEN ABLE TO  
ACCORDING TO A POLICY IN THE FIELD OF INVESTMENT  
FEE OF \$1M PER YEAR IN THE FIELD OF INVESTMENT

"POTENTIAL FOR THE COMPANY TO REALIZE GAINS IN THE  
EXCESS OF \$500M IN THE FIELD OF INVESTMENT. THE  
SHARE OF THE INVESTMENT IN THE FIELD OF INVESTMENT  
\$220M. AS A RESULT OF THE INVESTMENT IN THE  
THE AIR FORCE. THE COMPANY HAS BEEN ABLE TO  
BUSINESS. THE COMPANY HAS BEEN ABLE TO  
PROCUREMENTS

"ALTHOUGH THE COMPANY HAS BEEN ABLE TO REALIZE  
COMPLETELY. THE COMPANY HAS BEEN ABLE TO REALIZE  
FEW MINUTES. THE COMPANY HAS BEEN ABLE TO REALIZE  
ENSURE THAT THE COMPANY HAS BEEN ABLE TO REALIZE  
PHASE. THE COMPANY HAS BEEN ABLE TO REALIZE  
PLANNING. THE COMPANY HAS BEEN ABLE TO REALIZE  
REFERRED TO THE COMPANY HAS BEEN ABLE TO REALIZE  
COMPUTER. THE COMPANY HAS BEEN ABLE TO REALIZE  
AN INTEGRAL. THE COMPANY HAS BEEN ABLE TO REALIZE  
TECHNOLOGY. THE COMPANY HAS BEEN ABLE TO REALIZE  
TO YOUR STRATEGY. THE COMPANY HAS BEEN ABLE TO REALIZE  
AVAILABLE.

"AFTER REVIEWING THE COMPANY'S PROPOSAL, THE  
PROPOSAL. THE COMPANY HAS BEEN ABLE TO REALIZE  
FACTORY. THE COMPANY HAS BEEN ABLE TO REALIZE  
THIS ANALYSIS. THE COMPANY HAS BEEN ABLE TO REALIZE  
DESIGNED. THE COMPANY HAS BEEN ABLE TO REALIZE  
AND PHASE. THE COMPANY HAS BEEN ABLE TO REALIZE  
PROPOSED. THE COMPANY HAS BEEN ABLE TO REALIZE  
AND COST. THE COMPANY HAS BEEN ABLE TO REALIZE

"PHASE II OF THE TECH MOD PROGRAM IS THE PHASE WHEREIN DETAILED DESIGNS ARE ACCOMPLISHED, ENABLING TECHNOLOGY DEVELOPMENT TAKES PLACE, PROJECTS ARE PROTOTYPED HEURISTICALLY, AND INTEGRATED INFORMATION RESOURCE MANAGEMENT (IRM)/MANAGEMENT INFORMATION SYSTEM (MIS) PLANS ARE COORDINATED AND FINALIZED. IN ADDITION, AIR FORCE TECH MODS REQUIRE A COMPREHENSIVE OVERALL QUALITY ASSURANCE (Q.A.) PLAN.

"PHASE III OF THE TECH MOD IS THE PHASE WHEREIN FINAL DESIGNS ARE COMPLETED, BUILDING AND EQUIPMENT MODIFICATIONS ARE MADE, SYSTEMS ARE INSTALLED AND PROJECT COST SAVINGS ARE TRACKED TO ENSURE THAT PROGRAM OBJECTIVES ARE ACHIEVED.

THE DOTTED BAR EXTENDING BACK INTO PHASE I INDICATES THAT, IN MANY CASES, PROJECTS ARE IDENTIFIED EARLY IN THE PROGRAM THAT THE CONTRACTOR WISHES TO IMMEDIATELY IMPLEMENT AND GAIN THE SAVINGS. THE TECH MOD PROGRAM CONCEPT DOES NOT PROHIBIT SUCH ACTION."



## TECH MOD CONCEPT

### PARTNERSHIP TO IMPROVE PRODUCTIVITY

INDUSTRY	GOVERNMENT
● MODERNIZE MANUFACTURING FACILITIES	● PROVIDE INCENTIVES
INVEST IN NEW SYSTEMS, NEW	FUND ANALYSIS AND DESIGN
EQUIPMENT AND FACILITY IMPROVEMENTS	PROVIDE TERMINATION LIABILITY PROTECTION
IMPLEMENT IMPROVED SYSTEMS	PROVIDE AWARD FEES
● REDUCE COST OF WEAPON SYSTEMS	MAKE SAVING
● WINS	● WINS
LARGER PROFIT AND MORE COMPETITIVE	MAKE BANG FOR THE BUCK
POSITION WITH REDUCED FINANCIAL RISK	

INSTRUCTIONAL OBJECTIVE: To orient executive management to the fact that the Air Force Tech Mod Concept is a partnership to improve productivity.

NARRATION: "THE U.S. AIR FORCE TECH MOD CONCEPT IS INTENDED TO BE A PARTNERSHIP BETWEEN GOVERNMENT AND INDUSTRY TO IMPROVE PRODUCTIVITY.

"ON THE INDUSTRY SIDE OF THE LEDGER, THE TECH MOD MODERNIZES MANUFACTURING FACILITIES BY INCENTIVIZING INDUSTRY TO INVEST IN NEW SYSTEMS, NEW EQUIPMENT AND FACILITY IMPROVEMENTS AND TO IMPLEMENT IMPROVED SYSTEMS. THE RESULT OF THIS ACTION IS REDUCED COST OF WEAPON SYSTEMS AND WINS LARGER PROFITS AND MORE COMPETITIVE POSITION FOR INDUSTRY WITH REDUCED FINANCIAL RISK.

"ON THE GOVERNMENT SIDE OF THE LEDGER, THE GOVERNMENT PROVIDES INCENTIVES TO FUND ANALYSIS AND DESIGN, AND PROVIDES TERMINATION LIABILITY PROTECTION COUPLED WITH AWARD FEES. THE GOVERNMENT EXPECTS TO SIGNIFICANTLY SHARE IN THE SAVINGS RESULTING FROM THE TECH MOD PROGRAM. IT THEREBY WINS MORE 'BANG FOR THE BUCK."

## TECH MOD PROGRAMS

- ESTABLISH NEW PRODUCTION PROCESSES
- PROVIDE TECHNOLOGY TRANSFER
- STIMULATE IMPLEMENTATION & INVESTMENT
- DIRECTLY SUPPORTS SMALL BUSINESS & B/SIC INDUSTRIES (30-40%)
- BUILD UPON R&D PRECURSOR DEMONSTRATIONS
- IMPACT ACQUISITION & OPERATIONS & MAINTENANCE ROI

INSTRUCTIONAL OBJECTIVE: To orient executive management relative to TECH MOD program activities.

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NARRATION: "TECH MOD PROGRAMS ESTABLISH NEW PRODUCTION PROCESSES AND PROVIDE FOR TECHNOLOGY TRANSFER BETWEEN COMPANIES.

TECH MOD PROGRAMS STIMULATE IMPLEMENTATION OF NEW TECHNOLOGY AND SYSTEMS AND THE INVESTMENT BY DEFENSE CONTRACTORS. THEY DIRECTLY SUPPORT SMALL BUSINESS AND BUILD UPON R & D PRECURSOR DEMONSTRATION.

"IT IS THE INTENT OF TECH MOD PROGRAMS TO IMPACT THE GOVERNMENT'S ACQUISITION, OPERATIONS AND MAINTENANCE "RETURN ON INVESTMENT (ROI)."

## ICAM ANALYTICAL / PLANNING TOOLS

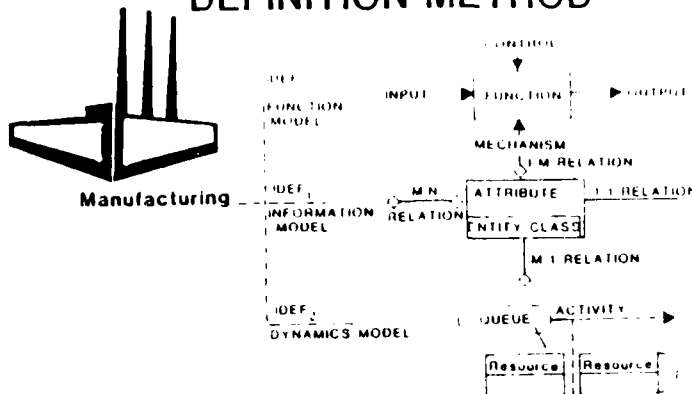
INSTRUCTIONAL OBJECTIVE: To convince executive management that the ICAM Program has developed useful analytical and planning tools for managing the introduction of new technology.

NARRATION: "AS WE DISCUSSED EARLIER, THE ICAM PROGRAM RECOGNIZED THAT THE SUCCESSFUL INTEGRATION OF NEW TECHNOLOGY MAY BE AS SIGNIFICANT, IF NOT MORE SO, THAN TECHNOLOGY ITSELF IN TERMS OF CONTRIBUTING TO PRODUCTIVITY IMPROVEMENT.

THERE ARE MANY ASPECTS TO TECHNOLOGY IMPLEMENTATION, BUT ONE STANDS OUT AMONG ALL OTHERS. IF NOT DONE, IT WILL EITHER PRECLUDE OR SERIOUSLY HAMPER IMPROVED PRODUCTIVITY NO MATTER HOW WELL EVERYTHING ELSE IS DONE.

THAT KEY FACTORY IS UNDERSTANDING THE EXISTING ENVIRONMENT. THAT IS WHY THE "SYSTEMATIC APPLICATION OF COMPUTER TECHNOLOGY" IS EMPHASIZED IN THE ICAM PROGRAM PURPOSE."

## IDEF - A SYSTEM DEFINITION METHOD



INSTRUCTIONAL OBJECTIVE: To answer the question "What is IDEF?" for executive level management.

NARRATION: "IDEF IS THE "ICAM DEFINITION" METHOD, LANGUAGE OR TECHNIQUE. IDEF IS A MODELING METHODOLOGY WHOSE PURPOSE IS TO GRAPHICALLY CAPTURE CHARACTERISTICS OF THE MANUFACTURING FUNCTIONS, INFORMATION SUPPORT FUNCTIONS, AND THE DYNAMICS OF THE FUNCTION AND INFORMATION INTERACTION.

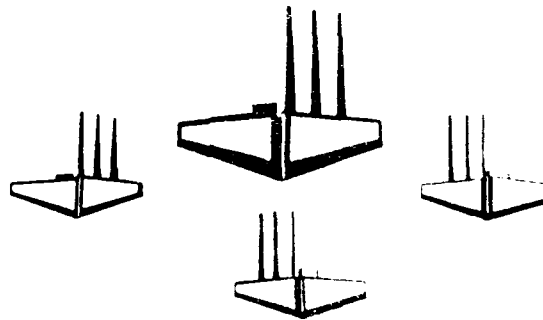
"WE CAN DEFINE IDEF AS SHOWN IN THIS GRAPHIC THREE-PRONGED SYSTEM DEFINITION METHOD BY WHICH WE CAN:

- 0 DEFINE PROBLEMS AND THEIR SOLUTIONS
- 0 FACILITATE COMMUNICATION AND ANALYSIS
- 0 ANSWER QUESTIONS ABOUT MANUFACTURING

"EACH OF THE THREE MODELS INDIVIDUALLY AS WELL AS COLLECTIVELY FORM AN "ARCHITECTURE" WHEN THE ENVIRONMENT OR SYSTEM BEING MODELED IS COMPRISED OF COMPONENT SYSTEMS, ORGANIZATIONS OR TECHNOLOGIES WHICH MUST WORK TOGETHER AS A HIGHER LEVEL SYSTEM, ENVIRONMENT OR ENTERPRISE.

THE SIGNIFICANCE OF THE MODELS BEING REFERRED TO AS ARCHITECTURES IS THAT THEY ARE "BLUEPRINTS" WHICH DESCRIBE GRAPHICALLY THE FUNDAMENTAL RELATIONSHIPS - THE FUNCTIONAL INTERFACES, COMMON/SHARED INFORMATION AND DYNAMICS INTERACTION - OF THE CONSTITUENT COMPONENTS OF THE SUBJECT ENVIRONMENT OR THE SYSTEM BEING MODELED."

## ICAM IDEF -- ARCHITECTURE



INSTRUCTIONAL OBJECTIVE: To answer the question "What is IDEF?"  
for executive level management.

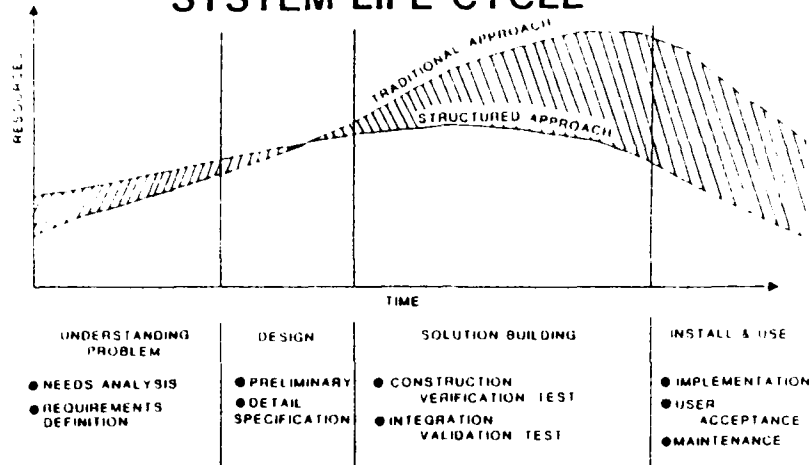
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NARRATION: "IT IS IMPORTANT TO RECOGNIZE, HOWEVER, THAT THE MODELS ARE IN FACT ARCHITECTURES ONLY WHEN USED AS ARCHITECTURES - THAT IS, TO BETTER UNDERSTAND, COMMUNICATE AND ANALYZE THE SUBJECT ENVIRONMENT OR SYSTEM AND HOW ITS COMPONENTS FIT TOGETHER FOR THE PURPOSE OF IMPROVING OVERALL PRODUCTIVITY."

"THE ICAM ARCHITECTURE, CREATED THROUGH THE USE OF IDEF MODELING TECHNIQUES, REPRESENTS A "COMPOSITE VIEW" OF AEROSPACE MANUFACTURING. THIS "COMPOSITE VIEW" WAS CREATED FROM THE VARIOUS "FACTORY VIEWS" GENERATED BY MEMBERS OF ICAM AEROSPACE INDUSTRY COALITION TEAMS.

"WHAT IS NOT IMMEDIATELY APPARENT IS THAT AN ARCHITECTURE - AS A MEANS TO PRODUCTIVITY IMPROVEMENT - IS IN ESSENCE A "STANDARD FOR COMMUNICATION." AS DISCUSSED EARLIER, ALL THREE IDEF MODELS PROVIDE INSIGHT WHICH IS FACILITATED BY THE REVIEW OF THE MODELS BY THE PEOPLE INVOLVED TO BETTER UNDERSTAND THE SUBJECT ENVIRONMENT OR SYSTEM AND HOW TO IMPROVE IT. INSIGHT VIA COMMUNICATION IS PRIMARILY WHAT AN ARCHITECTURE PROVIDES TO THE PROCESS OF PRODUCTIVITY IMPROVEMENT."

## IDEF -- ARCHITECTURE SYSTEM LIFE CYCLE



INSTRUCTIONAL OBJECTIVE: To answer the question "What is IDEF"? for executive level management.

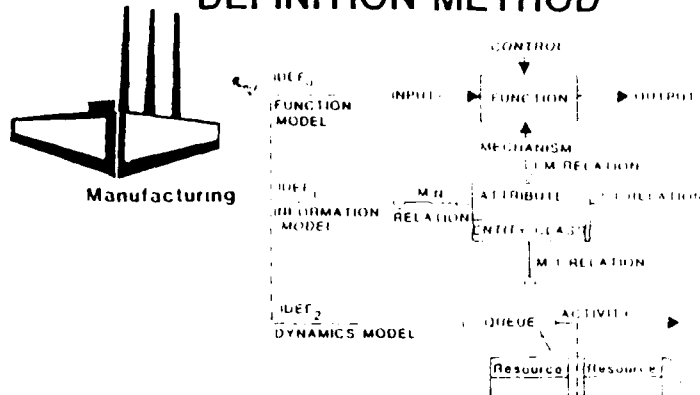
NARRATION: "THIS VIEW OF THE ICAM SYSTEM LIFE CYCLE PORTRAYS THE FACT THAT ADDITIONAL EXPENDITURE OF TIME AND EFFORT EARLY IN THE LIFE CYCLE "UNDERSTANDING THE PROBLEM" AND "DESIGNING THE SOLUTION" WILL RESULT IN SIGNIFICANT COST SAVINGS, AND PERHAPS TIME REDUCTION OVER THE LIFE CYCLE OF THE PROGRAM. WE REFER TO THE USE OF ARCHITECTURE AND IDEF METHODOLOGY AS THE "STRUCTURED APPROACH" VERSUS THE "TRADITIONAL APPROACH" ON THIS GRAPHIC PRESENTATION.

"IN AN ENVIRONMENT SUCH AS MANUFACTURING THERE ARE BASICALLY TWO AREAS OF COMMUNICATION WHICH NEED TO BE FACILITATED FOR PRODUCTIVITY IMPROVEMENT. FIRST AND FOREMOST IS THE NEED TO BETTER COMMUNICATE MANUFACTURING AMONG AND BETWEEN THE CROSS SECTION OF DISCIPLINES INVOLVED. MANUFACTURING IS CARRIED OUT BY MANY DIFFERENT PEOPLE REPRESENTING MANY DIFFERENT VIEWPOINTS, FROM WHICH TO COMMUNICATE, BASED UPON THEIR UNIQUE EXPERIENCE, RESPONSIBILITY AND PURPOSE. THE METHODS USED TO COMMUNICATE TRANSCENDS VIEWPOINT AND PROMOTES A COLLECTIVE, IMPROVED UNDERSTANDING OF MANUFACTURING TAKING ADVANTAGE OF ALL VIEWPOINTS.

"ANOTHER IMPORTANT ADVANTAGE OF USING AN ARCHITECTURE AND MODELING METHODOLOGY IN THE PROCESS OF PRODUCTIVITY IMPROVEMENT, IS THAT IT SERVES AS A BRIDGE BETWEEN THE MANAGEMENT AND TECHNICAL ENDEAVORS. AN ARCHITECTURE CAN BE USED AS BOTH A MANAGEMENT AND AS A TECHNICAL TOOL. MANAGERS ARE CONCERNED WITH PLANNING, CONTROLLING, AND ORGANIZING AND COORDINATING; WHILE TECHNICAL PEOPLE ARE CONCERNED WITH ANALYZING, INTEGRATING AND DESIGNING PRODUCTIVITY IMPROVEMENTS. ABOVE ALL WHAT IS MOST IMPORTANT IS TO RECOGNIZE THAT THEY MUST WORK TOGETHER TO IMPROVE MANUFACTURING AND COMMUNICATION BY WHATEVER MEANS IS IMPERATIVE.

"SOME BELIEVE THAT THIS CONCEPT AND APPROACH TO SYSTEM LIFE CYCLE MANAGEMENT IS THE AREA WHEREIN JAPANESE INDUSTRY REPEATEDLY OUT PERFORMS MUCH OF U.S. INDUSTRY."

## IDEF - A SYSTEM DEFINITION METHOD



INSTRUCTIONAL OBJECTIVE: To introduced executive management to the IDEF0 function modeling methodology.

NARRATION: "WHAT IS NEEDED IS A SET OF TOOLS AND METHODOLOGIES WHICH WILL ALLOW THE MANUFACTURING SYSTEM OR DEVELOPER TO:

- 0 PROVIDE A COMMON BASIS FOR COMMUNICATION.
- 0 PROVIDE FOR ESTABLISHMENT OF COMPOSITE DEFINITION FROM MANY INDIVIDUAL COMPANIES SPECIFIC DEFINITIONS.
- 0 PROVIDE A DESCRIPTIVE AND REPRESENTATIVE DOCUMENTATION OF THE OBJECTS OF THE COMPONENT SYSTEMS UTILIZING A COMMON SET OF CHARACTERISTICS.
- 0 SERVE AS THE INTEGRATION MECHANISM FOR APPLICATION SUPPORT SUBSYSTEMS.
- 0 SERVE AS THE BASIS FOR SYSTEM DESIGN, CONSTRUCTION, TEST AND IMPLEMENTATION.



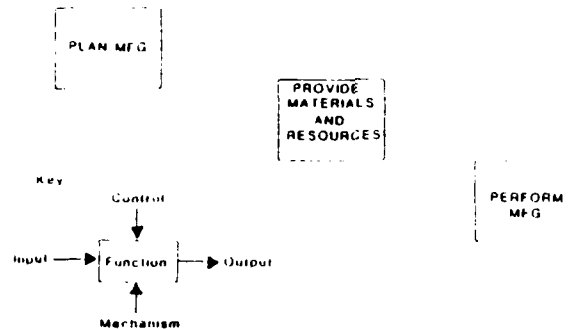
- 0 BE UTILIZED BY MANUFACTURING PERSONNEL IN AN EFFECTIVE MANNER.
- 0 HAVE A FORMAL BASIS SO THAT AUTOMATED ANALYZERS AND CONSTRUCTION AIDS COULD BE BUILT.
- 0 BE VALIDATED BY BOTH EXPERT REVIEW AND SIMULATION TECHNIQUES.

"THE ICAM PROGRAM DECIDED TO PURSUE THREE MODELING METHODOLOGIES CONSIDERING THE FOLLOWING FACTORS:

- 0 INDEPENDENTLY DEVELOPED MODELS, WHICH ARE VALIDATED AGAINST ONE ANOTHER AS AN APPROACH TO INTEGRATION, PROVIDE A GREATER ASSURANCE THAT THE IMPORTANT CHARACTERISTICS WILL BE ISOLATED AND DOCUMENTED BY AT LEAST ONE OF THE MULTIPLE INQUIRIES.
- 0 SINCE THE PRIMARY MECHANISM FOR VALIDATION IS EXPERT REVIEW, MULTIPLE MODELS ALLOW FOR SIMPLIFICATION OF THE CONCEPTS AND SYNTAX FOR EACH REVIEW AND THEREBY ENHANCE COMMUNICATION.
- 0 MULTIPLE MODELS ALLOW THE DEFINITION PROCESS TO BE SEGMENTED INTO MANAGEABLE PIECES.

"LET'S FIRST EXAMINE HOW AN IDEFO FUNCTION MODEL ANSWERS SPECIFIC QUESTIONS RELATIVE TO THE BASIC FUNCTIONAL BREAKDOWN OR DECOMPOSITION OF THE MANUFACTURING ENTERPRISE."

## IDEF<sub>0</sub> → FUNCTION MODEL



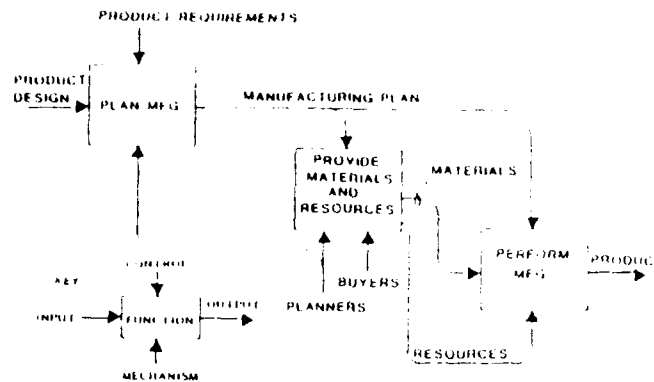
INSTRUCTIONAL OBJECTIVE: To introduced executive management to the IDEF0 function modeling methodology.

NARRATION: "LET'S CONSTRUCT A TOP-LEVEL FUNCTION MODEL OF A MANUFACTURING ENTERPRISE'S PRODUCTION ACTIVITY:

- O PLAN MANUFACTURING
- O PROVIDE MATERIAL AND RESOURCES
- O PERFORM MANUFACTURING

"PLEASE NOTE THE KEY PROVIDED IN THE LOWER LEFT CORNER TO FACILITATE YOUR UNDERSTANDING THROUGH THE NEXT STEPS IN OUR MODEL CONSTRUCTION."

## IDEF -- FUNCTION MODEL



INSTRUCTIONAL OBJECTIVE: To introduced executive management to the IDEF0 function modeling methodology.

NARRATION: "WHAT IS BEING TRANSFORMED AND WHAT IS THE RESULT? HERE WE INPUT "PRODUCT DESIGN" IN THE FUNCTION OF "PLAN MANUFACTURING."

"OUR PRODUCT DESIGN "INPUT" IS BEING TRANSFORMED INTO A MANUFACTURING PLAN AND EVENTUALLY INTO A PRODUCT "OUTPUT."

"THE "OUTPUT" OF THE FUNCTION "PROVIDE MATERIAL AND RESOURCES" IS "MATERIALS AND RESOURCES."

"IN ORDER TO ACCOMPLISH OUR "PERFORM MANUFACTURING" FUNCTION, WE MUST "INPUT" MATERIALS.

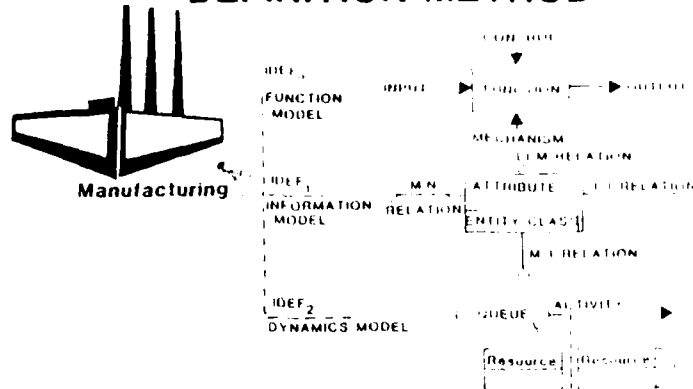
"WHAT INFLUENCES THESE FUNCTIONS? "PLAN MANUFACTURING" IS CONTROLLED BY "PRODUCT REQUIREMENTS." "PROVIDE MATERIAL AND RESOURCES" AND "PERFORM MANUFACTURING" ARE CONTROLLED BY THE "MANUFACTURING PLAN."

"WHAT IS NECESSARY TO CARRY OUT THESE FUNCTIONS?  
"PERFORM MANUFACTURING" REQUIRES THE MECHANISM OF  
"RESOURCES" SUCH AS EQUIPMENT, TOOLS AND PEOPLE. THE  
OTHER FUNCTIONS REQUIRE PLANNERS AND BUYERS.

"THIS IDEFO MODEL DIAGRAM ILLUSTRATES THAT:

IDEF IS USED TO PRODUCE A FUNCTION MODEL PER-  
SPECTIVE, A BLUEPRINT, A STRUCTURED DESCRIPTION  
OF WHAT IS BEING PERFORMED. WE MAY FURTHER  
DECOMPOSE EACH OF THESE FUNCTIONS TO PROVIDE A  
BREAKDOWN TO ANY DESIRED LEVEL OF DETAIL, THERE-  
BY PROVIDING A FUNCTIONAL ARCHITECTURE OR FRAME-  
WORK OF MANUFACTURING."

## IDEF - A SYSTEM DEFINITION METHOD



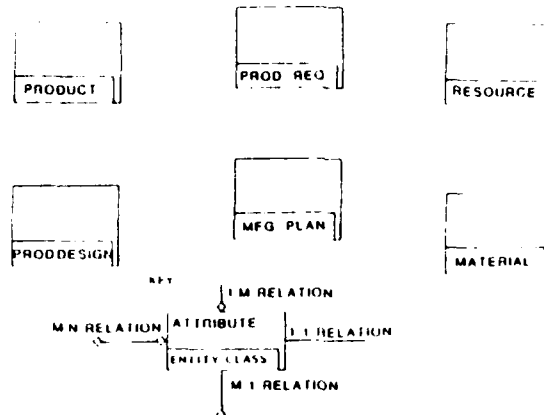
INSTRUCTIONAL OBJECTIVE: To introduce executive management to the IDEF1 information modeling methodology.

NARRATION: "THE IDEF 1 INFORMATION MODEL PROVIDES AND IN-DEPTH DESCRIPTION OF INFORMATION BY FOCUSING ON THE STRUCTURE OF INFORMATION IN SUPPORT OF WHAT IS BEING PERFORMED.

WE FEEL THAT THIS MODELING PERSPECTIVE IS ABSOLUTELY ESSENTIAL FOR THE INTEGRATION OF IDEFO FUNCTION MODELS AND THE DEVELOPMENT OF AN INTEGRATED DATABASE.

"THE IDEF1 INFORMATION MODELS ARE PROVING TO BE ONE OF ICAM'S KEY SYSTEM INTEGRATION TOOLS."

## IDEF<sub>1</sub> -- INFORMATION MODEL

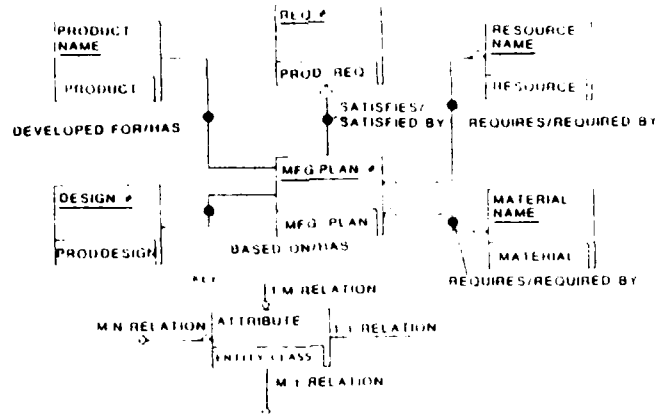


INSTRUCTIONAL OBJECTIVE: To introduce executive management to the IDEF1 information modeling methodology.

NARRATION: "AN IDEF1 INFORMATION MODEL CAN ANSWER SPECIFIC QUESTIONS REGARDING ANY INFORMATION ELEMENT (ENTITY CLASS) - SOMETIMES THE IDEF1 MODEL ANSWERS QUESTIONS NOT DEFINABLE IN IDEFO FUNCTION MODELS.

"PLEASE NOTE THAT WE HAVE AGAIN PROVIDED A MODEL KEY ON EACH OF THESE PRESENTATIONS TO FACILITATE YOUR UNDERSTANDING. THE IDEF1 PRIMITIVES ARE ENTITIES, ATTRIBUTES AND RELATIONS."

## IDEF, -- INFORMATION MODEL



INSTRUCTIONAL OBJECTIVE: To introduce executive management to the IDEF1 information modeling methodology.

NARRATION: "WHAT ARE THE RELATIONS OF ALL OF THE OTHER INFORMATION ENTITIES SHOWN TO THE "MANUFACTURING" ENTITY CLASS?"

- 0 EACH "PRODUCT" HAS A SPECIFIC "MANUFACTURING PLAN"
- 0 EACH DESIGN HAS A SPECIFIC "MANUFACTURING PLAN"
- 0 MANY PRODUCT REQUIREMENTS MAY BE SATISFIED BY THE "MANUFACTURING PLAN"
- 0 MANY "RESOURCES" ARE REQUIRED BY THE "MANUFACTURING PLAN"
- 0 MANY "MATERIALS" ARE REQUIRED BY THE "MANUFACTURING PLAN"

"FOLLOWING THE SAME ANALYSIS TECHNIQUE, WE HAVE PROVIDED THE RELATION DIAGRAMMING FOR THE OTHER ENTITY RELATION CLASSES SHOWN. (INSTRUCTOR MAY REVIEW EACH USING "MANUFACTURING PLAN" AS "CENTER.")

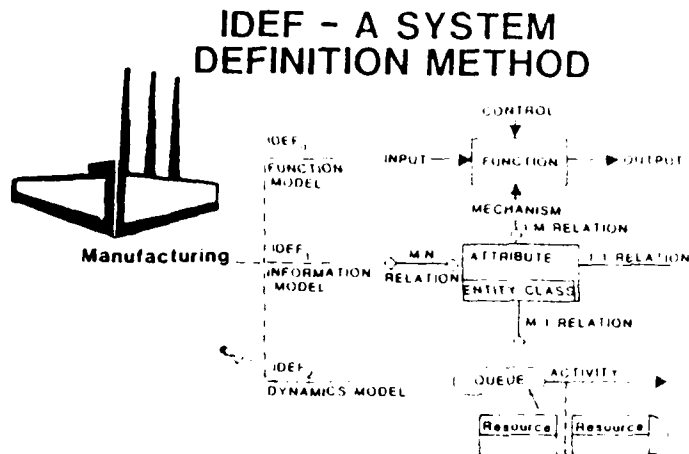
"IDEF1 IS USED TO PRODUCE AN INFORMATION MODEL PERSPECTIVE, A "DATA DICTIONARY" AND A STRUCTURED DESCRIPTION OF THE BASIC INFORMATION ELEMENTS.

"THE MODEL DEFINES, CROSS REFERENCES, RELATES AND CHARACTERIZES INFORMATION TO THE LEVEL OF DETAIL NECESSARY TO SUPPORT AND INTEGRATE THE MANUFACTURING ENVIRONMENT.

"IDEF 1 MODELS ARE ESSENTIAL TO COMMUNICATE THE INTERRELATIONSHIP OF INFORMATION AND TO PLAN INTEGRATED COMPUTER-AIDED MANUFACTURING.

"IDEF 1 MODELS PROVIDE THE BASIS TO ANALYZE THE COMMON, SHARED AND PRIVATE INFORMATION NEEDS OF THE MANUFACTURING ENVIRONMENT."

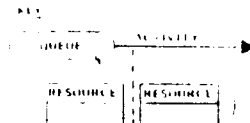




INSTRUCTIONAL OBJECTIVE: To introduce the IDEF2 dynamics modeling methodology.

NARRATION: "THE IDEF 2 DYNAMICS MODEL REPRESENTS THE TIME DEPENDENT CHARACTERISTICS OF MANUFACTURING TO DESCRIBE AND ANALYZE THE BEHAVIOR OF FUNCTIONS AND INFORMATION INTERACTING OVER TIME."

## IDEF<sub>2</sub> -- DYNAMICS MODEL

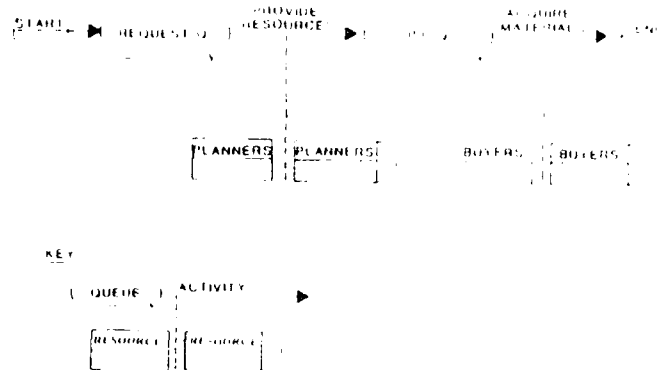


INSTRUCTIONAL OBJECTIVE: To introduce the IDEF2 dynamics modeling methodology.

NARRATION: "THE IDEF2 MODEL ANSWERS SPECIFIC QUESTIONS ABOUT ANY OBJECT OR INFORMATION AS IT PASSES THROUGH THE MANUFACTURING ENVIRONMENT, SUCH AS:

- 0 WHAT ACTIVITIES CONSUME TIME IN THE PROCESSING OF A MANUFACTURING PLANT?
- 0 WHAT TIME IS CONSUMED IN WAITING TO BE PROCESSED BY THE ACTIVITIES?"

## IDEF<sub>2</sub> → DYNAMICS MODEL



INSTRUCTIONAL OBJECTIVE: To introduce the IDEF2 dynamics modeling methodology.

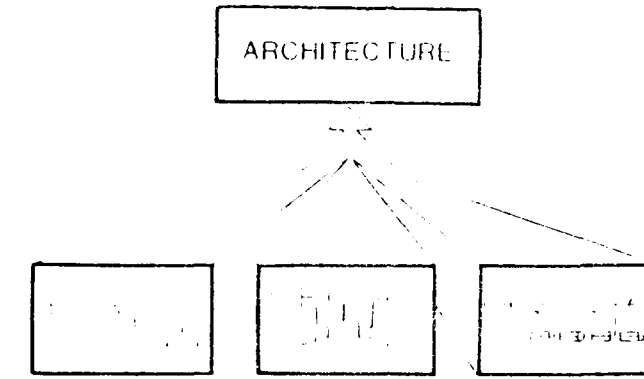
NARRATION: "WHAT RESOURCES ARE ALLOCATED, UTILIZED AND DEALLOCATED BY THE ACTIVITIES?"

"ONCE THESE QUESTIONS HAVE BEEN ANSWERED, BECAUSE OF TIME RELATIVE INFORMATION ASSOCIATED WITH EACH QUESTION, FURTHER QUESTIONS MAY BE ANSWERED REGARDING PERFORMANCE OF FLOW - SUCH AS:

WHAT IS THE TOTAL PROCESSING TIME OF THE MANUFACTURING PLAN? WHAT IS THE TOTAL TIME OF MANUFACTURING PLAN IS WAITING IN QUEUE TO BE PROCESSED? WHAT IS THE UTILIZATION OF RESOURCES AND WHAT STATISTICS ARE ASSOCIATED WITH THESE TIMES?

"IDEF2 THEREFORE, IS USED TO PRODUCE A DYNAMICS MODEL, A "SCENARIO" - A STRUCTURED DESCRIPTION OF THE TIME ORIENTED BEHAVIOR OF FUNCTIONS AND INFORMATION, AND PREVIOUS QUANTITATIVE INFORMATION AS TO THE SEQUENCE, DURATION AND FREQUENCY AT A LEVEL OF DETAIL NECESSARY TO ANALYZE HOW MANUFACTURING IS PERFORMED. (I.E. COMMUNICATION OF FUNCTION/INFORMATION INTERRELATION - ANALYSIS OF RESOURCE UTILIZATION AND THROUGHPUT TIME COSTS.)"

## ARCHITECTURE



INSTRUCTIONAL OBJECTIVE: To provide executive management with an understanding that all three IDEF0, IDEF1, and IDEF2 modeling methodologies constitute the generic manufacturing architecture.

NARRATION: "INDIVIDUALLY AND COLLECTIVELY:

- 0 IDEF0 FUNCTION MODELS PROVIDE A  
"BLUEPRINT OF FUNCTIONS"
- 0 IDEF1 INFORMATION MODELS PROVIDE A  
"DICTIONARY OF INFORMATION"
- 0 IDEF2 DYNAMICS MODELS PROVIDE A  
"SCENARIO OF FUNCTION/INFORMATION  
INTERACTION."

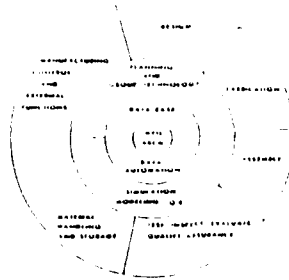
"ALL THREE MODELING METHODOLOGIES AND THEIR  
RESPECTIVE ARCHITECTURES FORM THE ICAM ARCHITECTURE."

"EACH OF THE MODELS REPRESENT A DISTINCT BUT RELATED  
VIEW OF MANUFACTURING."

"EACH USES A STRUCTURED TOOL METHOD TO  
UNDERSTAND, COMMUNICATE AND ANALYZE EXISTING AND  
FUTURE MANUFACTURING.

"EACH SUPPORTS THE DEVELOPMENT OF STATE-OF-THE-ART  
MANUFACTURING TECHNOLOGY AND INTEGRATION OF THAT  
TECHNOLOGY INTO EXISTING MANUFACTURING."

ICAM  
INTEGRATED  
COMPUTER AIDED MANUFACTURING



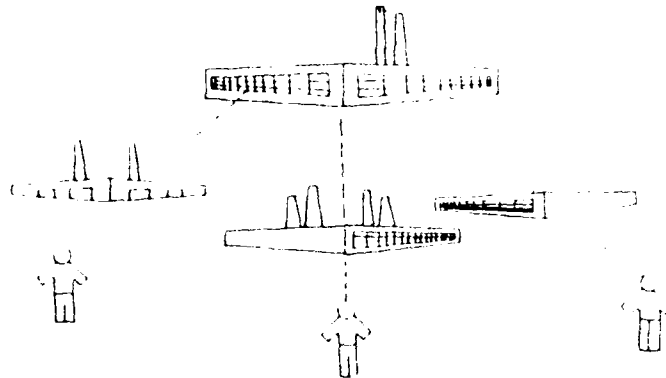
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INSTRUCTIONAL OBJECTIVE: To provide executive management with an understanding of the importance of the manufacturing architecture developed via the IDEF methodologies.

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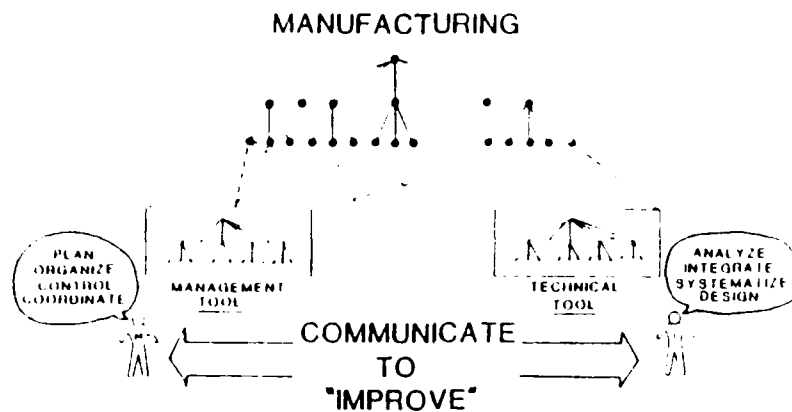
NARRATION: "THIS ICAM LOGO ILLUSTRATES THE IMPORTANCE PLACED BY THE AIR FORCE UPON THE MANUFACTURING ARCHITECTURE DEVELOPED BY THE IDEF METHODOLOGIES. IT IS THE CENTER PIECE OF THE ICAM PROGRAM, THE BASIS FOR DEVELOPING INTEGRATED DATABASES AND DATA AUTOMATION.

"THE MANUFACTURING ARCHITECTURE HAS BEEN THE CENTER TARGET OF THE ICAM PROGRAM SINCE THE EARLY DAYS OF ITS INCEPTION. ALL OF THE WORK ACCOMPLISHED TO DATE INDICATES THAT THE SELECTION OF THIS "BULL'S-EYE" WAS FORWARD LOOKING AND AN ACCURATE FORECAST OF THE ICAM PROGRAM'S NEEDS."



"THE GENERIC ARCHITECTURE PROVIDES A STANDARD FOR ORGANIZATIONAL COMMUNICATION, UNDERSTANDING AND ANALYSIS."

## ARCHITECTURE



INSTRUCTION OBJECTIVE: To provide executive management with an understanding of the importance of the manufacturing architecture developed via the IDEF methodologies.

NARRATION: "THE MANUFACTURING ARCHITECTURE PROVIDES BOTH A MANAGEMENT TOOL AND A TECHNICAL TOOL TO IMPROVE UNDERSTANDING AND COMMUNICATION.

"MANAGEMENT CAN USE THE ARCHITECTURE TO PLAN, ORGANIZE AND CONTROL THE INTEGRATION OF NEW MANUFACTURING TECHNOLOGY.

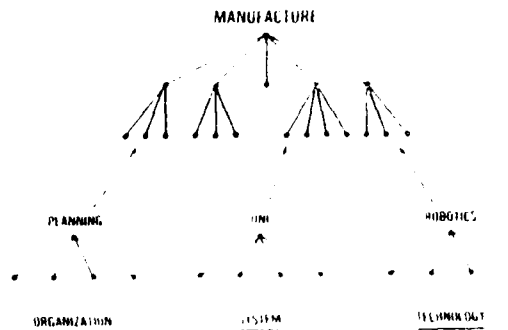
"TECHNICAL PERSONNEL CAN USE THE ARCHITECTURE TO ANALYZE, INTEGRATE, SYSTEMATIZE AND DESIGN OF NEW TECHNOLOGY.

"AND MAYBE MORE IMPORTANT--TO IMPROVE COMMUNICATION BETWEEN EACH OTHER"!!!



## STANDARD FOR COMMUNICATION

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INSTRUCTIONAL OBJECTIVE: To provide executive management with an understanding of the importance of the manufacturing architecture developed via the IDEF methodologies.

NARRATION: "IN SUMMARY, WE NEED AN "ARCHITECTURE" TO FACILITATE PUTTING VIEWPOINTS INTO PERSPECTIVE AND TO PROVIDE A COMMON BASIS UPON WHICH WE CAN DEAL WITH ALL ASPECTS OF MANUFACTURING. (I.E. ORGANIZATION, SYSTEM, AND TECHNOLOGIES.)

"THIS ARCHITECTURE MUST PROVIDE A FRAMEWORK, A ROAD MAP, A BLUEPRINT, A DICTIONARY FROM WHICH WE CAN DEPART AND REFERENCE BACK TO. THE KEY TO INCREASED MANUFACTURING PRODUCTIVITY IS TO DO IT SMARTER. TO DO IT SMARTER, WE MUST INTEGRATE AND TO INTEGRATE WE MUST BETTER UNDERSTAND HOW ALL THE "PIECES" FIT TOGETHER. WE MUST UNDERSTAND BETTER OUR OWN DOMAIN AND HOW WE FIT INTO THE WHOLE.

"GIVEN THAT OUR OBJECTIVE IS TO IMPROVE MANUFACTURING PRODUCTIVITY, THE TASK WILL REQUIRE US TO INTEGRATE THE MANAGEMENT AND OPERATIONS OF MANUFACTURING. THIS MEANS NOT JUST TO INTEGRATE COMPUTERS TOGETHER BUT INTEGRATE WHAT COMPUTERS WILL ENABLE. (I.E. INTEGRATED ORGANIZATIONS, SYSTEMS, AND TECHNOLOGIES.)

IDEF IS THE METHOD  
ARCHITECTURE IS THE MEANS  
PRODUCTIVITY IS THE OBJECTIVE

10 49

INSTRUCTIONAL OBJECTIVE: To provide executive management with ICAM's understanding of the relationship of IDEF, architecture, and productivity.

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NARRATION: "IDEF IS THE METHOD!!

"ARCHITECTURE IS THE MEANS!!

"PRODUCTIVITY IS THE OBJECTIVE!!

"THE ICAM ARCHITECTURE HAS NOW MATURED TO THE POINT WHERE THE AIR FORCE HAS BEEN ABLE TO UTILIZE THE "AS-IS" ARCHITECTURE AS A BASELINE FROM WHICH THE FACTORY OF THE FUTURE CAN BE DEFINED.

"THE VOUGHT CORPORATION HAS BEEN AWARDED A "TO-BE" ARCHITECTURE CONTRACT FOR A "CONCEPTUAL DESIGN FOR COMPUTER INTEGRATED MANUFACTURING (CIM)" FOR THE AEROSPACE FACTORY OF THE FUTURE. (AS A POINT OF INTEREST, THE VOUGHT CORPORATION HAS INDEPENDENTLY DECIDED TO USE THE IDEF MODELING METHODOLOGIES TO COMPLETED MODEL THEIR "AS-IS" BUSINESS STRUCTURE.)

"BESIDES SUPPORT TO THE ICAM PROGRAM, THE ARCHITECTURE ALSO SUPPORTS THE AIR FORCE'S TECHNOLOGY

MODERNIZATION. THE ICAM PROGRAM AND THE AIR FORCE LOGISTIC COMMAND RELATE PROGRAMS. THESE PROGRAMS MAY ACCELERATE THE MANAGEMENT OF TECHNOLOGY CHANGE BY TAKING ADVANTAGE OF THE ICAM ARCHITECTURE.

"IN ADDITION, THE ARMY HAS RECOGNIZED THE BENEFITS OF THE ICAM ARCHITECTURE AND IS USING IT IN SUPPORT OF THE ELECTRONIC COMPUTER-AIDED MANUFACTURING (ECAM) PROGRAM, A TRI-SERVICE ACTIVITY. THE ECAM PROGRAM, MANAGED BY THE U.S. ARMY MISSILE COMMAND, REDSTONE ARSENAL, ALABAMA, IS THE FIRST MAJOR CAD/CAM PROGRAM OUTSIDE OF THE AIR FORCE TO APPLY THE CONCEPTS PIONEERED BY THE ICAM PROGRAM ON A BROAD SCALE. THE PRIMARY OBJECTIVE OF THE INITIAL PHASE OF THE ECAM EFFORT IS TO ESTABLISH AN ICAM LIKE MASTER PLAN FOR DEVELOPING STRATEGY AND CONCEPTS FOR AUTOMATED SYSTEMS TO BE UTILIZED IN THE DESIGN, MANUFACTURE AND TEST OF ELECTRONIC EQUIPMENT.

"NEITHER HAVE THE BENEFITS THAT CAN BE DERIVED FROM THE ARCHITECTURE BEEN MISSED BY COMPANIES THAT HAVE BECOME FAMILIAR WITH IT THROUGH THEIR EXPERIENCE WITH THE ARCHITECTURE. FIVE MAJOR COMPANIES ARE KNOWN TO BE USING IT IN INTERNAL MODERNIZATION PROGRAMS.

"THE CONTINUED MAINTENANCE OF THE ARCHITECTURE IS LIKELY TO IMPROVE ITS APPLICATION FOR INDUSTRY TO A GREATER EXTENT. THE U.S. HAS RECOGNIZED THE NEED TO IMPROVE THE PRODUCTIVITY AND RESPONSIVENESS OF THE DEFENSE INDUSTRIAL BASE, AND IN PARTICULAR, THROUGH THE MECHANISM OF NATIONAL LEVEL CAD/CAM PROGRAMS. THE ARCHITECTURE OF MANUFACTURING IS NOW A KEY ELEMENT CONTRIBUTING TO MEETING THIS IMPORTANT NATIONAL OBJECTIVE.

"THE AIR FORCE ICAM PROGRAM IS ALSO FORGING AHEAD TO DEMONSTRATE AND VALIDATE THE BENEFITS OF COMPUTER-AIDED INTEGRATION OF MANUFACTURING BY CONSTRUCTING AN INTEGRATED SHEET METAL CENTER (ISMC) IN THE AEROSPACE INDUSTRY. THE FINAL ISMC DESIGN WILL BE COMPLETED BY FY84 AND INITIAL DEMONSTRATION AT THE SITE SELECTED WILL BE CONDUCTED IN FY85.

"THE ICAM SPONSORED ISMC IS INTENDED TO SHOW A CLEAR AND AUDIBLE TRACK OF THE MAGNITUDE AND SOURCE OF PRODUCTIVITY BENEFITS, FROM DESIGN THROUGH FACTORY FLOOR DEMONSTRATION."

ICAM INTEGRATED SHEET METAL CENTER (ISMC)

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<u>MACHINE UTILIZATION</u>	44%
<u>NUMBER OF:</u>	
• MACHINES	44%
• FLOOR SPACE	39%
• PEOPLE	44%
<u>THROUGHPUT</u>	25%
<u>COST:</u>	
• INITIAL	17%
• ANNUAL	24%

INSTRUCTIONAL OBJECTIVE: To orient executive management to ICAM ISMC goals.

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NARRATION: "IN SUMMARY, THE ICAM ISMC PROJECT WILL DEMONSTRATE THE TRANSITION OF THE ICAM PROGRAM FROM METHODOLOGY DEVELOPMENT TO ACTUAL APPLICATION.

"THE ISMC EFFORT WILL COVER PLANNING AND CONTROL, ISMC CAPACITY UTILIZATION, AND TECHNOLOGY TRANSFER.

"IN THE AREA OF PLANNING AND CONTROL, WE PLAN TO DEMONSTRATE THE FOLLOWING:

- 0 THE INTEGRATION OF MANUFACTURING SYSTEMS FROM PRODUCTION SCHEDULE GENERATION AND PROCESS PLANNING DOWN TO THE SHOP FLOOR.
- 0 COMPUTER-AIDED SHOP FLOOR CONTROL SYSTEM.
- 0 DECISION SUPPORT CAPABILITIES AT ALL LEVELS.
- 0 ALL ASSOCIATED PRODUCT ASSURANCE ACTIVITIES.

"IN THE AREA OF CAPACITY UTILIZATION, WE INTEND TO

DEMONSTRATE:

- O A FULL RANGE OF SHEET METAL FABRICATION PROCESSES.
- O FULLY AUTOMATED BLANKING AND STRAIGHT-LINE BENDING CELLS.
- O PART FAMILIES, MATERIALS AND GAUGES REPRESENTING 88% OF AEROSPACE SHEET METAL FABRICATION.
- O APPROXIMATELY 750,000 PARTS PER YEAR CAPABILITY.

"THE END OBJECTIVE IS, OF COURSE, TO ACHIEVE TECHNOLOGY TRANSFER RECOGNIZING:

- O ISMC IS A MAJOR PART OF COMMITTED AEROSPACE PRODUCTION.
- O ISMC IS MODULAR IN DESIGN.
- O ISMC WILL PROVIDE CLEAR, OPEN BENEFITS TRACKING.
- O ISMC WILL BE A LONG-TERM, EXPANDING DEMONSTRATION.

"THERE ARE MANY TANGIBLE ISMC PAYOFFS TO BE DEMONSTRATED:

- O LOWER FABRICATION COSTS.
- O REDUCE WORK IN-PROCESS INVENTORY.
- O IMPROVED DIRECT LABOR PRODUCTIVITY.
- O ENHANCE MACHINE UTILIZATION.
- O SIMPLER, FASTER RESPONSE TO ENGINEERING CHANGES.
- O IMPROVED SHOP FLOOR CONTROL WITH LOWER COSTS.
- O HIGHER MORE CONSISTENT PRODUCT QUALITY.

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8 September 1983

"IN ADDITION, WE ANTICIPATE SEVERAL INTANGIBLE ISMC  
PAYOFFS:

- 0 IMPROVED MANAGEMENT VISIBILITY AND CONTROL OF  
ALL AREAS, INCLUDING DATA PROCESSING, MORE  
SATISFYING WORK ENVIRONMENT.
- 0 MORE SATISFYING WORK ENVIRONMENT.
- 0 INCREASED RESPONSIVENESS.
- 0 HIGHER SEARCH CAPABILITY.
- 0 REDUCED FACILITY AND EQUIPMENT CAPITAL  
REQUIREMENTS.
- 0 GREATER PRODUCTIVITY OF "INDIRECT" FUNCTIONS  
DOING PLANNING AND SCHEDULING.

# INTEGRATED STRATEGIC PLANNING AND INFORMATION RESOURCE MANAGEMENT

INSTRUCTIONAL OBJECTIVE: To provide executive management with further understanding of the requirements for "top-down" factory analysis and technology modernization (TECH MOD) management planning.

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NARRATION: "STRATEGIC PLANNING IS A PROCESS FOR EXERCISING FAVORABLE INFLUENCE OVER FUTURE EVENTS. IT INVOLVES ACTIVITIES PERFORMED AT A HIGH LEVEL WITHIN THE ORGANIZATION AND IS CRITICAL TO SUCCESS.

"COMPETING IN A WORLD OF RAPIDLY CHANGING TECHNOLOGIES CAN BE LIKENED TO PLAYING A VIDEO GAME. THE TARGET CONSTANTLY MOVES AND NEW OPPONENTS ZOOM IN FROM VARIOUS VECTORS. FOCUSING SOLELY ON ONE TARGET SOMETIMES MEANS LOSING THE GAME TO AN UNEXPECTED FOE THAT HAS BEEN OVERLOOKED IN THE FRAY. TO PLAY THE GAME WELL, A NEW SET OF SKILLS IS REQUIRED; HIGHTENED REFLEXES PLUS THE ABILITY TO ANTICIPATE CHALLENGES AND MAKE FAST, RATIONAL DECISIONS.

"THE SINGLE MOST IMPORTANT CHALLENGE FACING MANUFACTURING EXECUTIVES TODAY MAY WELL BE THE STRATEGIC PLANNING FOR THE INTRODUCTION OF NEW INFORMATION RESOURCE MANAGEMENT AND AUTOMATION TECHNOLOGY. SINCE COMPUTERS ARE AN INTEGRAL PART OF MOST OF THIS TECHNOLOGY, GREAT STRIDES CANNOT BE MADE UNTIL MANAGEMENT GETS COMFORTABLE WITH COMPUTERS AND DEVELOPS A POSITIVE, AGGRESSIVE ATTITUDE TOWARD THEIR USE.

"AUTOMATION MUST BECOME THE FOCUS OF TECHNOLOGY MODERNIZATION, NOT THE BI-PRODUCT OF IT. THIS IS WHAT LIES BEHIND THE EMERGENCE OF COMPUTER INTEGRATED MANUFACTURING (CIM) AS A MAJOR FORCE IN THE PROCESS OF INDUSTRIAL MODERNIZATION.

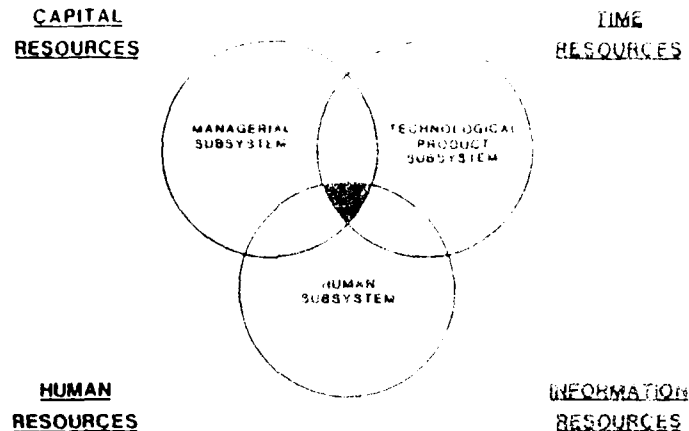
"NEVER BEFORE HAS THERE BEEN SO MUCH CONFUSION IN TERMINOLOGY, SUCH AN ABUNDANCE OF TECHNOLOGY, SUCH A VARIETY OF ALTERNATIVES, AND SUCH A MULTITUDE OF SUGGESTIONS ON WHICH COURSE TO FOLLOW. UNFORTUNATELY, IT IS APPARENT THAT MANY ORGANIZATIONS ARE MOVING RIGHT AHEAD IN THE APPLICATION OF NEW TECHNOLOGY, WITHOUT MUCH, IF ANY CONCERN ON HOW THESE MOVES WILL AFFECT OR ANSWER THE REAL INFORMATION NEEDS OF THE ENTERPRISE.

"JOE FERREIRA OF THE DIEBOLD GROUP STATED; 'WHAT IS IMPORTANT IS TO GAIN A CONCEPTUAL UNDERSTANDING OF WHAT IS TAKING PLACE, TO UNDERSTAND YOUR NEED FOR INFORMATION, TO KNOW WHERE IT IS AND WHAT YOUR INFORMATION RESOURCES ARE. INFORMATION IS COMING INTO ITS OWN AS A CORPORATE RESOURCE, AND ORGANIZATIONS HAVE A NEW OPPORTUNITY TO DO WHAT THEY SHOULD HAVE BEEN DOING ALL ALONG - GET BACK TO FUNDAMENTALS AND DETERMINE HOW THEY USE INFORMATION.'

"THE AIR FORCE'S ICAM FACTORY OF THE FUTURE PROJECT IS DEVELOPING A STRATEGY TO ACHIEVE A COMPUTER INTEGRATED MANUFACTURING FRAMEWORK THAT INTEGRATES, INTERFACES, AND INTERACTS ALL MAJOR MANUFACTURING ENTERPRISE ACTIVITIES AND SYSTEMS. SCOPING AND NEEDS ANALYSIS WORK TO DATE INDICATES THAT THE ICAM ANALYTICAL/PLANNING TOOLS DISCUSSED THUS FAR IN OUR PRESENTATION WILL ALSO BE VERY PRODUCTIVE IN THIS MANAGEMENT AREA."



## RESOURCE MANAGEMENT



INSTRUCTIONAL OBJECTIVE: To provide executive management with an understanding of the socio-technical model and resource management.

NARRATION: "WORK ACCOMPLISHED BY THE ICAM MANUFACTURING CONTROL - MATERIAL MANAGEMENT (MCMM) DEMONSTRATION PROJECT AT THE NORTHROP CORPORATION PROVIDED US WITH A SOCIO-TECHNICAL MODEL VIEWPOINT OF ENTERPRISE MANAGEMENT.

"THIS VIEWPOINT PORTRAYS THE INTERRELATIONSHIP OF THREE MAJOR SUBSYSTEMS FOR CONSIDERATION:

"TECHNOLOGICAL PRODUCT SUBSYSTEM - THIS SUBSYSTEM INCLUDES THE TECHNOLOGICAL REQUIREMENTS DEFINITION AND PLANNING ACTIVITIES OF THE MANUFACTURING ENTERPRISE. GENERALLY SPEAKING, MANUFACTURING BEGINS WITH DESIGN - THE FIRST STEP AND PROCEEDS THROUGH VARIOUS PLANNING STEPS TO PREPARE FOR PRODUCTION. AS AN EXAMPLE, THE FUNCTIONS OF DESIGN, PROCESS PLANNING, MAKE OR BUY DECISIONS, MANUFACTURING PLANNING, ETC. OCCUR HERE. (THIS IS A KEY AREA FOR ACHIEVING CIM REWARDS IN THAT THE INTEGRATION/INTERFACING/INTERACTING OF THESE INFORMATIONAL ACTIVITIES APPEAR TO OFFER A SIGNIFICANT REDUCTION IN MANUFACTURING LEAD TIME AND IMPROVEMENT IN QUALITY.)"

"MANAGERIAL SUBSYSTEM - THIS SUBSYSTEM INTEGRATES THE VARIOUS ACTIVITIES WITHIN THE FACTORY AND THE INFORMATION ASSOCIATED WITH THOSE ACTIVITIES. IT IS WITHIN THIS SUBSYSTEM THAT MANAGEMENT'S POLICIES, BUDGETS, AND PLANS ARE CONVERTED INTO THE DIRECTIVES, OPERATIONAL PLANS AND SCHEDULES REQUIRED TO PRODUCE THE PRODUCT.

"HUMAN SUBSYSTEM - THIS SUBSYSTEM INCLUDES THE OVERALL ORGANIZATION CLIMATE, WILLINGNESS TO ACCEPT CHANGE, WORK GROUP FACTORS AT ALL LEVELS, HUMAN RESOURCES DEVELOPMENT, AND JOB SATISFACTION. MUCH EFFORT HAS GONE INTO IMPROVING THE ABILITY OF A DRILL TO PENETRATE METAL, BUT MUCH LESS TIME HAS BEEN COMMITTED TO THE OPERATOR THAT IS INVOLVED. ENERGY GOES INTO IMPROVING CAD SYSTEMS BUT LESS INTO THE ROLE OF THE DESIGNER WHO MUST WORK IN FRONT OF THAT CAD SYSTEM. WORKER'S DISSATISFACTION WITH THEIR ENVIRONMENT, THEIR LACK OF LOYALTY TO A CORPORATION, ARE ONLY SYMPTOMS OF SHORTCOMINGS IN THE MANAGEMENT/WORKER RELATIONSHIP. (THE TERM WORKERS, IN THIS CASE, REFERS TO ALL PEOPLE FROM THE FACTORY FLOOR TO THE EXECUTIVE SUITE.)

"EXECUTIVE LEVEL MANAGEMENT FUNCTIONS WITHIN THIS COMPLEX THREE-SUBSYSTEM ENVIRONMENT WHILE MANAGING THE FOUR KEY RESOURCES AT ITS DISPOSAL:

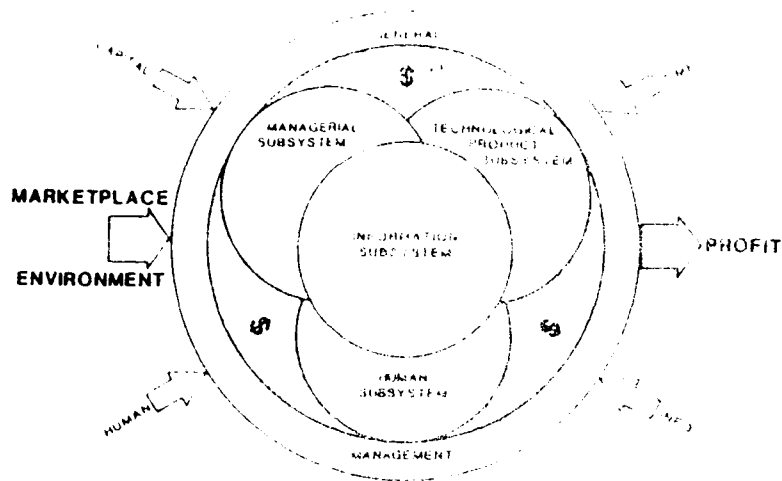
"CAPITAL RESOURCES - THE COMPLEX WORLD OF AVAILABLE FINANCING, HIGH INTEREST RATES, CASH FLOW, AND THE IMPACT UPON INTERNAL OPERATIONAL PLANS AND BUDGETS.

"TIME RESOURCES - THE IRREPLACEABLE EXPENDITURE OF 24 HOURS IN EACH DAY AND 365 DAYS IN EACH CALENDAR YEAR.

"HUMAN RESOURCES - PERHAPS THE MOST CRITICAL OF THE RESOURCES, THE AREA WHEREIN AN ORGANIZATION RETAINS ITS MARKETPLACE AND PRODUCT KNOWLEDGE, EXPERIENCE AND CREATIVITY.

"INFORMATION RESOURCES - THE ENTERPRISE'S BUSINESS AND PRODUCT KNOWLEDGE IS DESCRIBED AND RETAINED IN ITS INTERNAL INFORMATION STRUCTURE. CLEARLY, THE HEART OF THE INTEGRATED MODERN FACTORY IS ITS ABILITY TO EFFICIENTLY AND EFFECTIVELY HANDLE INFORMATION. NO ONE EXCEPT DIRECT 'TOUCH LABOR' DOES ANYTHING EXCEPT GENERATE, STORE, RETRIEVE AND MANIPULATE INFORMATION.

## INFORMATION RESOURCE MANAGEMENT



**INSTRUCTIONAL OBJECTIVE:** To orient executive management relative to the importance of information resource management in preparation for further emphasis on the ICAM analytical/planning tools.

**NARRATION:** "THIS INFORMATION RESOURCE MANAGEMENT (IRM) MODEL BUILDS UPON THE PRIOR SOCIO-TECHNICAL MODEL IN THAT IT HIGHLIGHTS THE RELATIONSHIP OF THE MANAGEMENT INFORMATION SUBSYSTEM TO THE PREVIOUSLY DESCRIBED SUBSYSTEMS.

"IN ADDITION, IT RECOGNIZES THAT GENERAL MANAGEMENT (I.E. THE GENERAL MANAGER AND HIS TOP FUNCTIONAL STAFF) MUST CONSTANTLY FOCUS UPON THE EXTERNAL MARKETPLACE AND ENVIRONMENT WITH THE END OBJECTIVE OF PRODUCING A SATISFACTORY PROFIT FOR THE ENTERPRISE.

"GENERAL MANAGEMENT CONTROLS THE ALLOCATION AND EXPENDITURE OF CAPITAL, TIME, HUMAN AND INFORMATION RESOURCES PRIMARILY THROUGH THE TOOLS OF FINANCIAL CONTROL AND EXCHANGE OF INFORMATION BETWEEN THE ACTIVITIES AND FUNCTIONS OF THE ORGANIZATION.

"AS TECHNOLOGY MODERNIZATION OPPORTUNITIES ARE ANALYZED AND SELECTED FOR IMPLEMENTATION, IT IS THIS EXCHANGE OF MANAGEMENT INFORMATION BETWEEN THE ORGANIZATIONAL ACTIVITIES THAT WILL UNITE AND INTEGRATE THE INDIVIDUAL 'ISLAND OF TECHNOLOGY' PROJECTS."

INFORMATION RESOURCE MANAGEMENT (IRM)

**"INFORMATION IS THE MANAGER'S MAIN TOOL.  
INDEED THE MANAGER'S CAPITAL, AND IT IS HE  
WHO MUST DECIDE WHAT INFORMATION HE NEEDS  
AND HOW TO USE IT."**

PETER DRUCKER, "MANAGING THE INFORMATION AGE," 1980

INSTRUCTIONAL OBJECTIVE: To orient senior management to the relationship between Information Resource Management and the ISAM tool methodology and architecture.

NARRATION: "THE PRECEDING MATERIAL LEADS TO THE CONCLUSION THAT PETER DRUCKER STATED IN HIS ARTICLE 'MANAGING THE INFORMATION EXPLOSION'.

"INFORMATION IS THE MANAGER'S MAIN TOOL. INDEED THE MANAGER'S CAPITAL, AND IT IS HE WHO MUST DECIDE WHAT INFORMATION HE NEEDS AND HOW TO USE IT."

"WE BELIEVE THAT THE ISAM TOOL METHODOLOGIES AND ARCHITECTURE PROVIDE YOU WITH ADDITIONAL MANAGEMENT ANALYTICAL AND PLANNING TOOLS FOR LINKING YOUR STRATEGIC BUSINESS PLANNING ACTIVELY WITH THE DAY-TO-DAY OPERATIONAL ASPECTS OF YOUR BUSINESS."

## INTEGRATED STRATEGIC PLANNING AND IRM

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- ONLY 19% OF THE COMPANIES SURVEYED HAVE INTEGRATED THEIR STRATEGIC PLANNING AND INFORMATION RESOURCE MANAGEMENT (IRM) SYSTEMS\*
- THE COMPANIES THAT DID SO OUTPERFORMED THE REST OF THE SAMPLE BY ABOUT 300% OVER FIVE YEARS ON SUCH MEASURES AS:
  - AVERAGE RETURN ON EQUITY
  - RETURN ON TOTAL CAPITAL
  - NEW PROFIT MARGINS\*

(REF: A.T. KEARNEY INC. MANAGEMENT CONSULTING, CHIEF OF 40 OF 500  
LARGEST U.S. INDUSTRIAL AND FINANCIAL INSTITUTIONS)

INSTRUCTIONAL OBJECTIVE: To provide executive management with an example of the results of Integrated Strategic Planning and Information Resource Management.

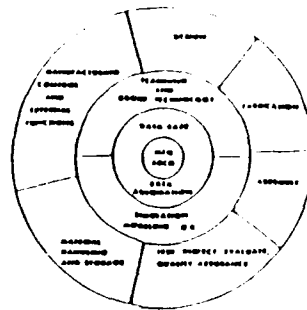
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NARRATION: "A RECENT RESEARCH PROJECT WAS PERFORMED BY A. T. KEARNEY ON HOW WELL COMPANIES EFFECTIVELY MANAGE THEIR INFORMATION RESOURCES.

"THE STUDY DISCLOSED THAT THE ORGANIZATIONS THAT HAVE USED FORMAL STRUCTURED BUSINESS AND SYSTEMS PLANNING TO ORGANIZE, MONITOR AND CONTROL THEIR INFORMATION RESOURCES, OUT PERFORM THE REST OF THE SAMPLE BY ABOUT 300% IN TERMS OF AN AVERAGE RETURN ON EQUITY, RETURN ON TOTAL CAPITAL AND NET PROFIT MARGINS OVER A FIVE YEAR PERIOD.

"THIS OFFERS PROOF THAT AN EFFECTIVE INTEGRATED INFORMATION RESOURCE MANAGEMENT SYSTEM HAS A SUBSTANTIAL POSITIVE AFFECT ON BOTTOM-LINE RESULTS."

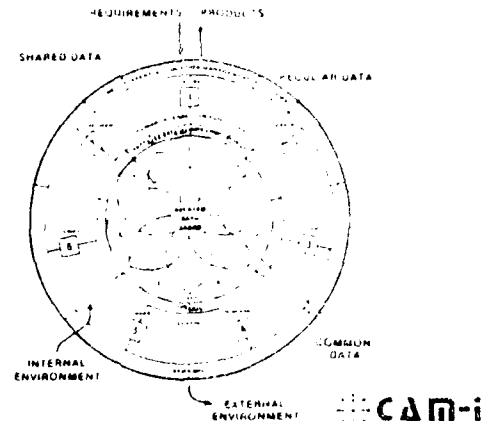
ICAM  
INTEGRATED  
COMPUTER-AIDED MANUFACTURING



INSTRUCTIONAL OBJECTIVE: To provide executive management with an example of the results of Integrated Strategic Planning and Information Resource Management.

NARRATION: "AGAIN, IT INDICATES THAT THE ICAM PROGRAM CORRECTLY FOCUSED ON AN INTEGRATED MANUFACTURING SYSTEMS ARCHITECTURE, COUPLED WITH DATABASE DESIGN AND DATA AUTOMATION. THIS ARCHITECTURE CAN BECOME THE FOCAL POINT FOR PLANNING AND CONTROLLING THE FUNCTIONS AND ACTIVITIES OF TOMORROW'S MANUFACTURING ENTERPRISE."

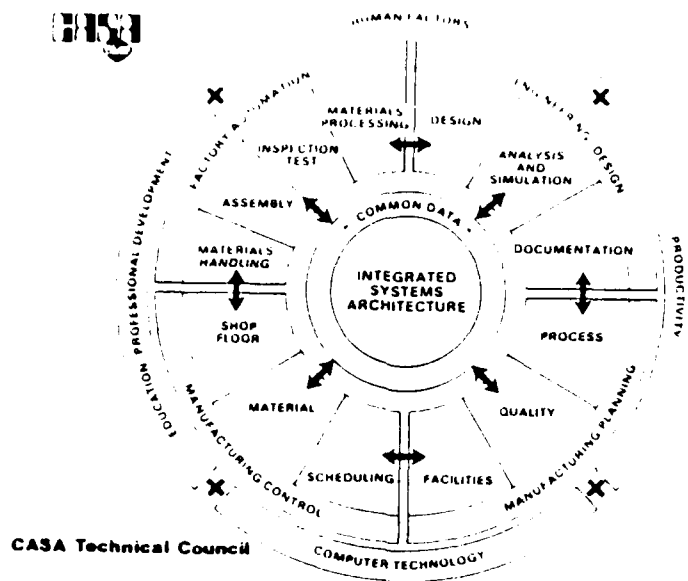
## DYNAMIC HUMAN DIRECTED COMPUTER-AIDED ACTIVITY MODEL



INSTRUCTIONAL OBJECTIVE: To familiarize executive management with other major U.S. activities concurring with ICAM's center focus on integrated system architecture and databases.

NARRATION: "COMPUTER-AIDED MANUFACTURING - INTERNATIONAL (CAM-I) IS A NON-PROFIT RESEARCH ORGANIZATION HEADQUARTERED IN ARLINGTON, TEXAS. CAM-I IS CONSTITUTED BY A LARGE NUMBER OF INSTITUTIONS FROM INDUSTRY AND ACADEMIA ON A WORLD-WIDE BASIS.

"THIS CAM-I 'DYNAMIC HUMAN DIRECTED COMPUTER-AIDED ACTIVITY MODEL' WAS DEVELOPED INDEPENDENTLY FROM THE ICAM PROGRAM'S ACTIVITIES. PLEASE NOTE, HOWEVER, THAT THE CENTRAL FOCUS OF THE CAM-I LOGO IS ALSO 'RELATED DATABASES'."



INSTRUCTIONAL OBJECTIVE: To familiarize executive management with other major U.S. activities concurring with ICAM's center focus on integrated system architecture and integrated databases.

NARRATION: "THE SOCIETY OF MANUFACTURING ENGINEER'S COMPUTER AND AUTOMATED SYSTEMS ASSOCIATION (SME CASA) RECENTLY PUBLISHED THIS LOGO DEVELOPED BY ITS TECHNICAL COUNCIL AND APPROVED BY ITS BOARD OF DIRECTORS.

"THE PURPOSE OF THE LOGO WAS TO ASSIST IN PLANNING COMPUTER INTEGRATED MANUFACTURING (CIM) PROGRAMS.

"PLEASE NOTE THAT, LIKE ICAM, SME CASA ALSO SEES INTEGRATED SYSTEMS ARCHITECTURE AND COMMON DATABASES AS THE CENTRAL FOCUS REQUIRED FOR FUTURE FACTORY INTEGRATION."



COMMON TERMINOLOGY

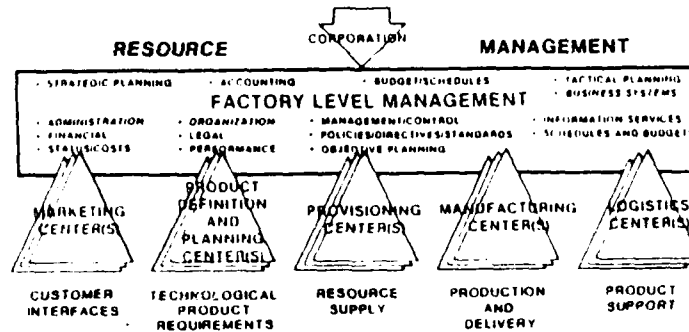
- FRAMEWORK
- ARCHITECTURE
- STRUCTURE
- "BLUE PRINT"
- "ROAD MAP"

INSTRUCTIONAL OBJECTIVE: To familiarize executive level management with the commonly used terminology relative to "frameworks" and "architectures."

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NARRATION: "IN SUMMARY, ICAM, CAM-I, AND SME CASA HAVE ALL ARRIVED AT THE SAME CONCLUSION ---- AN INTEGRATED MANUFACTURING SYSTEM ARCHITECTURE, COUPLED WITH INTEGRATED DATABASES, IS THE CENTER FOCUS OF EXECUTIVE MANAGEMENT'S "TOP-DOWN" PLANNING AND CONTROL NEEDS.

"EFFORTS SUCH AS THESE ARE NOW GENERATING A MORE COMMON UNDERSTANDING RELATIVE TO THE USE OF FRAMEWORKS AND ARCHITECTURES."

## FACTORY OF THE FUTURE FRAMEWORK



INSTRUCTIONAL OBJECTIVE: To orient executive level management to the scope of the Air Force's Factory of the Future Framework Project.

NARRATION: "THE ICAM PROGRAM'S FACTORY OF THE FUTURE PROJECT IS DIRECTED SPECIFICALLY AT DEVELOPING AN OVERALL CONCEPTUAL FRAMEWORK TARGETTED AT THE 1985 - 1990 TIME FRAME. THIS ICAM FRAMEWORK PROJECT TASK HAS TWO MAJOR OBJECTIVES:

- 0 TO ESTABLISH AN OVERALL CONCEPTUAL FRAMEWORK FOR THE AEROSPACE FACTORY OF THE FUTURE WHICH INCLUDES MULTI-PURPOSE PRODUCTION CENTERS (I.E., MACHINING, COMPOSITES, SHEET METAL, ELECTRONICS AND ASSEMBLY.
- 0 TO DEVELOP AND DEFINE A STRATEGY FOR ACHIEVING A COMPUTER INTEGRATED MANUFACTURING (CIM) FRAMEWORK THAT INTEGRATES, INTERFACES AND INTERACTS ALL MAJOR ACTIVITIES AND SYSTEMS.

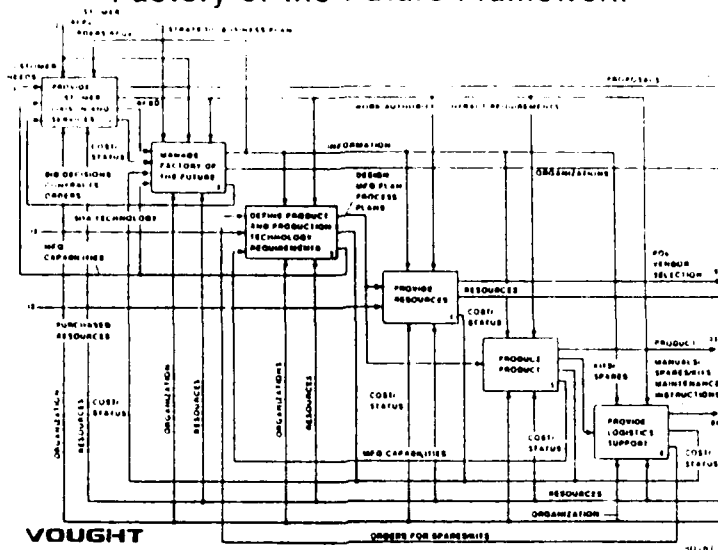
"THE ICAM FACTORY OF THE FUTURE FRAMEWORK, BEING DEVELOPED BY THE VOUGHT CORPORATION AND A SUPPORTING COALITION OF COMPANIES, INCORPORATED THIS PICTORIAL VIEW OF RESOURCE MANAGEMENT INTO THE APPROVED PROJECT SCOPING DOCUMENT.

"OTHER CURRENT AIR FORCE PROGRAMS ARE ADDRESSING THE DESIGN AND DEMONSTRATION OF INTEGRATED FACTORY FLOOR CENTERS. THESE CENTERS WILL BECOME A PART OF THE FACTORY OF THE FUTURE FRAMEWORK.

"THE FACTORY OF THE FUTURE FRAMEWORK WILL ALSO ADDRESS MARKETING, DESIGN AND MANUFACTURING ENGINEERING, ACQUISITION AND CONTROL OF RESOURCES AND LOGISTICS SUPPORT. THESE FUNCTIONS CAN ALSO BE VIEWED AS CENTER-CELL-STATION STRUCTURES THAT ARE INTEGRATED WITH THE PRODUCTION CENTERS THROUGH A FACTORY LEVEL MANAGEMENT SYSTEM STRUCTURE."

(CONDUCT A BRIEF WALKTHROUGH REVIEW OF THE DATA CONTAINED ON THE CHART.)

## Factory of the Future Framework



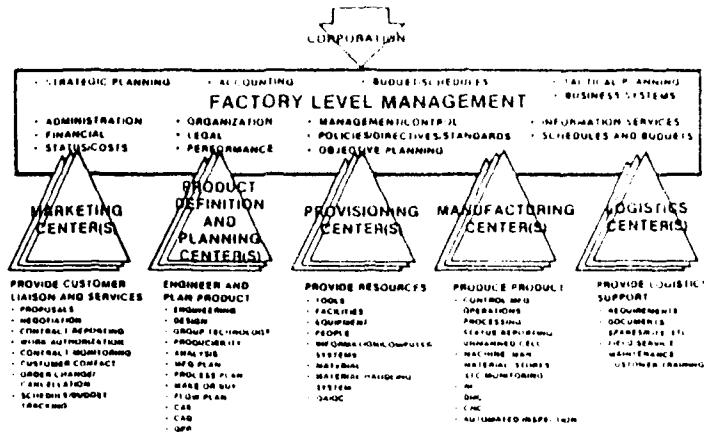
INSTRUCTIONAL OBJECTIVE: To orient executive level management relative to the use of ICAM IDEF methodologies on the Factory Of The Future contract.

NARRATION: "THIS IDEF<sub>0</sub> DIAGRAM DEVELOPED BY THE VOUGHT COALITION PORTRAYS THE SIX BASIC FUNCTIONS WE REVIEWED ON THE LAST CHART. OUR INTENT TODAY IS NOT TO COMPLETELY REVIEW ALL OF THE DETAILS SHOWN, BUT TO ILLUSTRATE A HIGHER ORGANIZATIONAL LEVEL USE OF THEIR ICAM PLANNING AND ANALYTICAL TOOLS.

"PLEASE NOTE THAT THE MANAGEMENT OF RESOURCES, DENOTED HERE AS "MANAGE FACTORY OF THE FUTURE," IS CONTROLLED BY BOTH THE ENTERPRISE'S STRATEGIC BUSINESS PLAN AND CUSTOMER REQUIREMENTS SUCH AS: REQUESTS FOR PROPOSALS (RFP), ORDERS AND REQUESTS FOR QUOTATIONS (RFQ). THE TWO OUTPUTS OF THIS MANAGEMENT FUNCTION ARE ORGANIZATIONS AND INFORMATION.

"FURTHER DECOMPOSITION OF EACH OF THESE FUNCTIONAL ACTIVITIES WILL HELP PROVIDE A "STANDARD FOR COMMUNICATION" IN PLANNING FOR FUTURE TECHNOLOGY MODERNIZATION ACTIVITIES."

## FACTORY OF THE FUTURE FRAMEWORK



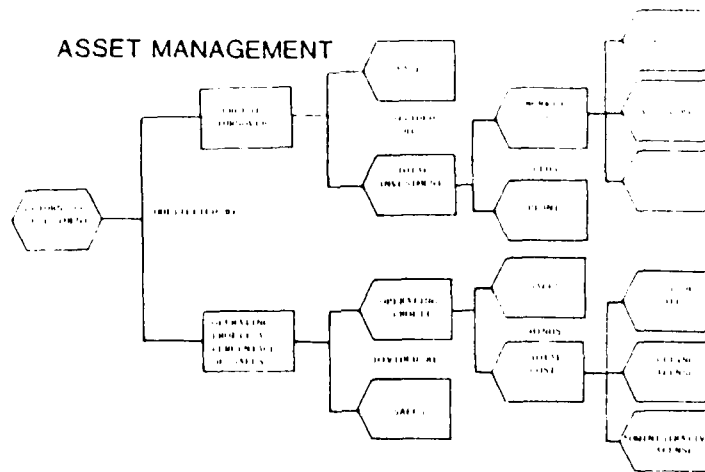
INSTRUCTIONAL OBJECTIVE: To orient executive management relative to further planned decomposition of the Factory Of The Future Framework.

NARRATION: "LISTED BELOW EACH OF THE TOP-LEVEL FUNCTIONS WE JUST ON THE IDEFO<sub>0</sub> DIAGRAM, WE FIND THE DECOMPOSITION OF MANY OTHER BUSINESS FUNCTIONS AND ACTIVITIES.

"AGAIN, OUR PURPOSE TODAY IS JUST TO ORIENT YOU TO THIS FUTURE POTENTIAL APPLICATION OF ICAM PLANNING AND ANALYTICAL TOOLS."

(BRIEFLY REVIEW THE MAJOR FUNCTIONS AND ACTIVITIES SHOWN ON THE CHART.)

CAPITAL vs. RETURN ON INVESTMENT (ROI)



INSTRUCTIONAL OBJECTIVE: To further orient executive management that the ICAM planning/analytical tools can be focused on asset management.

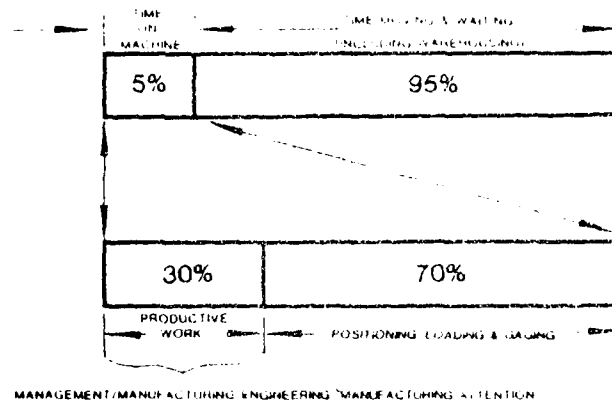
NARRATION: "THE FACTORY OF THE FUTURE CONTRACT IS ALSO MAINTAINING A FOCUS ON THE FACT THAT EXECUTIVE MANAGEMENT'S PRIMARY MOTIVATION IS AND SHOULD BE THE EFFICIENT USE OF CAPITAL.

"THIS ASSET MANAGEMENT RETURN ON INVESTMENT (ROI) FORMULA IS BEING USED AS A PLANNING TOOL BY THE COALITION. THIS EMPHASIS IS DIRECTLY RELATED TO THE 1980 DEPARTMENT OF DEFENSE DoD "STATEMENT OF PRINCIPLES FOR THE DoD MANUFACTURING TECHNOLOGY PROGRAM."

"THIS STATEMENT OF PRINCIPLES, APPROVED AND ISSUED TO ALL DEFENSE AGENCIES, STATES THE FOLLOWING RELATIVE TO "ROI CONSCIOUSNESS":

"A DEEPER AND MORE EXPLICIT CONSCIOUSNESS OF RETURN ON INVESTMENT MUST BE DEVELOPED AND USED BY ALL LEVELS OF MANAGEMENT OF THE MANUFACTURING TECHNOLOGY PROGRAM. WE MUST ASSURE THE HIGH LEVERAGE RETURN ON INVESTMENT POTENTIAL OF THE DoD MANUFACTURING TECHNOLOGY PROGRAM IS REALIZED."

## INVENTORY "TIME IN SHOP"



MANAGEMENT/MANUFACTURING ENGINEERING/MANUFACTURING ATTENTION

INSTRUCTIONAL OBJECTIVE: To further orient executive management that the ICAM planning/analytical tools are focused on asset management.

NARRATION: "FOR EXAMPLE, LET'S BRIEFLY FOCUS ON THE SUBJECT OF INVENTORY MANGEMENT."

"LOOKING AT THE PROBLEM FROM THE VIEWPOINT OF THE INVENTORY MATERIAL, THE TIME ACTUALLY SPENT ON A MACHINE (OR BEING ASSEMBLED) IS ACTUALLY FIVE PERCENT OF THE TIME BETWEEN THE RECEIVING DOCK AND PRODUCT SHIPMENT.

"A CLOSER EXAMINATION SHOWS THAT ONLY 30% OF THE FIVE PERCENT IS ACTUALLY IN PRODUCTIVE WORK. THE REMAINING 70 PERCENT IS POSITIONING, LOADING AND/OR GAUGING.

"THIS MEANS THAT APPROXIMATELY ONE AND ONE-HALF PERCENT OF THE MATERIALS "TIME IN SHOP" IS ACTUALLY SPENT IN PRODUCTIVE WORK. IN THE PAST, HOWEVER, WE HAVE TENDED TO FOCUS OUR ATTENTION ENTIRELY ON "PROCESS TECHNOLOGY" AND THAT HAS RESULTED IN "ISLANDS OF PROCESS TECHNOLOGY.

"AS STATED EARLY IN OUR PRESENTATION, WE BELIEVE WE MUST CHANGE THE FOCUS OF OUR RESOURCE EXPENDITURES WHILE STILL PURSUING IMPROVEMENTS IN "PROCESS TECHNOLOGY'."





INFORMATION RESOURCE AND HUMAN  
RESOURCE MANAGEMENT

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- THE PRODUCT OF ANY EMPLOYEE THAT DOES NOT LAY HANDS ON THE HARDWARE PRODUCT IS DATA AND OR DECISIONS.
- EMPLOYEE "PARTICIPATION" IS DEPENDENT UPON KNOWLEDGE OF THEIR SURROUNDING ENVIRONMENT AND CONTRIBUTION OF THEIR DATA.
- TEAM MANAGEMENT TECHNIQUES OFFER AN EXPLOSIVE IMPACT ON PRODUCTIVITY.
- TMT STRUCTURED METHODOLOGIES CHANNEL THIS ENERGY TOWARD "TOP-DOWN" PLANNING GOALS.

INSTRUCTIONAL OBJECTIVE: To further emphasize to executive management that use of the ICAM planning and analytical tools will be beneficial to their organization.

NARRATION: "THE LINKAGE OF INFORMATION RESOURCE MANAGEMENT AND HUMAN RESOURCE MANAGEMENT IS JUST BEGINNING TO BE UNDERSTOOD. YOU WILL PROBABLY THEREFORE, AGREE WITH THE FIRST TWO OBSERVATIONS ON THIS CHART:

"THE PRODUCT OF ANY EMPLOYEE THAT DOES NOT LAY HANDS ON THE HARDWARE PRODUCT IS DATA AND/OR DECISIONS.

"EMPLOYEE "PARTICIPATION" IS DEPENDENT UPON KNOWLEDGE OF THEIR SURROUNDING ENVIRONMENT AND CONTRIBUTION OF THEIR DATA.

"SUCCESSFUL "QUALITY CIRCLE" PROGRAMS IN THE UNITED STATES HAVE HIGHLIGHTED THE ABOVE ASSERTIONS.

"IN ADDITION, EXPERIENCE BY SUCCESSFUL IDEF METHODOLOGY MODELING TEAMS HAVE DEMONSTRATED THE LAST TWO ASSERTIONS:

"TEAM MANAGEMENT TECHNIQUES OFFER AN EXPLOSIVE IMPACT ON PRODUCTIVITY.

"TMT STRUCTURED METHODOLOGIES CHANNEL THIS ENERGY TOWARD "TOP-DOWN" PLANNING GOALS."

TEAM MANAGEMENT TECHNIQUES (TMT)

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- PROJECT DEFINITION
- ASSIGN PROJECT TEAMS
- SELECT TEAM MEMBERS
- MANAGE TEAM MEETINGS
- STRUCTURED ANALYTICAL INTEGRATION TOOLS
  - IDEF<sub>0</sub> FUNCTION/ACTIVITY MODELS
  - IDEF<sub>1</sub> INFORMATION MODELS
  - IDEF<sub>2</sub> DYNAMICS MODELS
  - COST DRIVER ANALYSIS (COST MODELS)
- ANTICIPATE FUTURE PROBLEMS

INSTRUCTIONAL OBJECTIVE: To further emphasize to executive management that use of the ICAM planning and analytical tools will be beneficial to their organization.

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NARRATION: "THESE IDEF MODELING TEAMS, LIKE ALL OTHER GROUP DYNAMICS, ACTIVITIES, ARE VERY DEPENDENT UPON CAREFUL PROJECT DEFINITION, ASSIGNMENT OF TEAM MEMBERS ON A VERY SELECTIVE BASIS, THE ABILITY OF THE PROJECT MANAGER TO MANAGE TEAMS, AND THE PROPER USE OF THE ICAM DEVELOPED STRUCTURED IDEF ANALYTICAL INTEGRATION TOOLS.

"WHEN APPLIED TO TECHNOLOGY MODERNIZATION PROJECTS, IT IS ALSO RECOMMENDED THAT SOME TRAINING BE PROVIDED TO THE PROJECT TEAM RELATIVE TO COST DRIVER ANALYSIS TECHNIQUES IN ORDER TO DEVELOP COST PERFORMANCE MODELS THAT CORRESPOND WITH THE OTHER IDEF MODELS.

"FREQUENTLY THE FUNCTIONING OF THESE TEAMS WILL IDENTIFY ANTICIPATED FUTURE PROBLEMS THEREBY AVOIDING COSTLY IMPACTS."

## INFORMATION RESOURCE MANAGEMENT (IRM)

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INSTRUCTIONAL OBJECTIVE: To further emphasize to executive management that use of the IRPM planning and analytical tools will be beneficial to their organization.

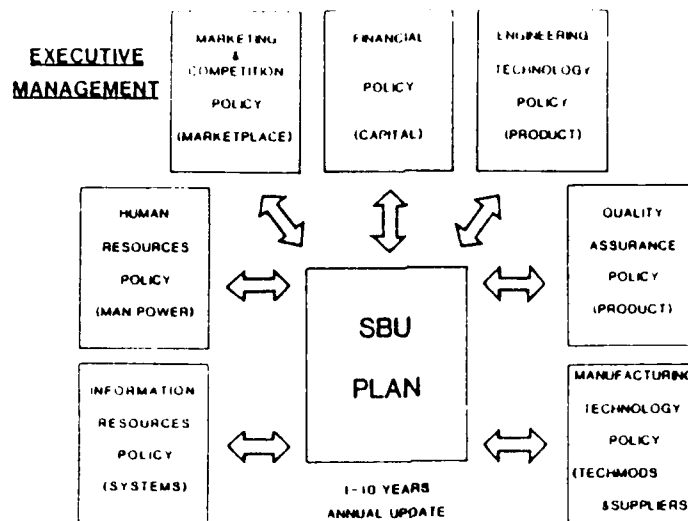
NARRATION: "THIS INFORMATION RESOURCE MANAGEMENT 'ORCHESTRATOR' CARTOON ILLUSTRATES OUR MANAGEMENT PREMISE FOR THE FACTORY OF THE FUTURE."

"THE SHEET MUSIC BEING READ BY THE 'COMPUTER BASED INFORMATION SYSTEM (CBIS) CONDUCTOR' IS COMPOSED OF IDEF0 FUNCTION MODEL DIAGRAMS. THE IDEF0 INFORMATION MODEL DATA STRUCTURE PERFORMS AS THE CONDUCTOR'S 'INTEGRATION TOOL' TO ORCHESTRATE THE ACTIVITIES OF ALL OF THE VARIOUS ORGANIZATIONAL FUNCTIONS PORTRAYED."

"FUNCTIONS AND ACTIVITIES CONTROLLED BY MANAGEMENT INFORMATION WILL CONSTITUTE THE FACTORY OF THE FUTURE'S INTEGRATED DATABASE."

"LET'S BRIEFLY WALKTHROUGH A HYPOTHETICAL 'TOP-DOWN' APPLICATION OF THIS PHILOSOPHY."

# STRATEGIC BUSINESS UNIT PLAN



INSTRUCTIONAL OBJECTIVE: To orient executive level management relative to the potential application of ICAM planning and analytical tools to everyday business requirements.

NARRATION: "LET'S ASSUME THAT OUR HYPOTHETICAL ORGANIZATION HAS IN PLACE A STRATEGIC BUSINESS PLANNING SYSTEM. LET'S ALSO ASSUME THAT ALL OF THE POLICIES ILLUSTRATED HERE ARE CLEARLY DELINEATED IN THIS STRATEGIC BUSINESS PLAN OUTLINING THE ORGANIZATION'S PLANNED DIRECTION FOR THE NEXT FIVE TO TEN YEARS.

"UP UNTIL VERY RECENTLY, OUR HYPOTHETICAL ORGANIZATION PROBABLY FOCUSED ITS STRATEGIC PLANNING ONLY ON THE POLICY AREAS OF THE MARKETPLACE, FINANCIAL POLICY, AND TECHNOLOGY AS IT RELATED TO THE ORGANIZATION'S PRODUCTS. MORE RECENTLY, HOWEVER, EXTERNAL AND INTERNAL ENVIRONMENTAL PRESSURES HAVE FOCUSED THE GENERAL MANAGER'S AND HIS TOP FUNCTIONAL STAFF'S ATTENTION ON THE OTHER FOUR AREAS REQUIRING POLICY DEFINITION (I.E., HUMAN RESOURCES, QUALITY ASSURANCE, MANUFACTURING TECHNOLOGY AND INFORMATION RESOURCES).

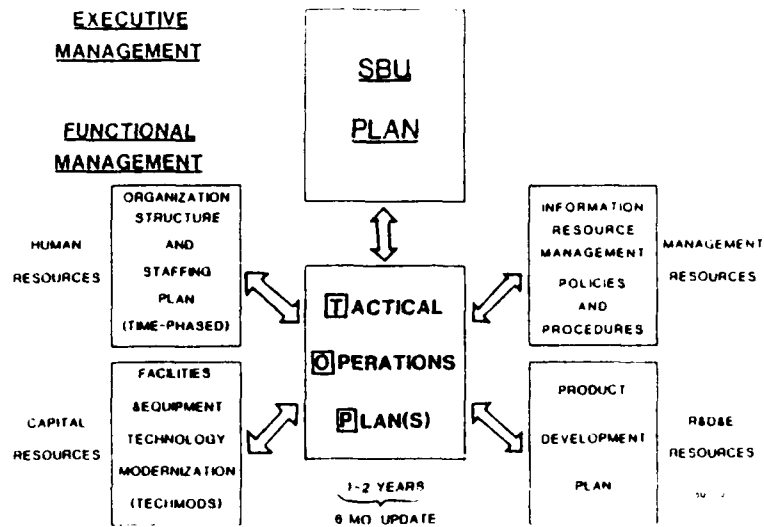
"LET'S ALSO ASSUME THAT THE PROGRESSIVE MANAGEMENT OF OUR HYPOTHETICAL ORGANIZATION RECOGNIZES THAT BETWEEN FORTY AND SIXTY PERCENT OF ITS PRODUCT COST IS

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8 September 1983

GENERATED BY ITS SUPPLIERS AND CONTRACTORS. THE ORGANIZATION MUST, THEREFORE, ESTABLISH AND MAINTAIN A MANUFACTURING TECHNOLOGY POLICY RELATIVE TO ITS MAJOR SUPPLIERS.

"PLEASE NOTE THAT THE TWO-WAY ARROWS INDICATE AN ITERATIVE PROCESS DURING PLAN DEVELOPMENT AND MAINTENANCE."

TACTICAL OPERATIONS PLAN(S)



INSTRUCTIONAL OBJECTIVE: To orient executive level management relative to the potential application of ICAM planning and analytical tools to everyday business requirements.

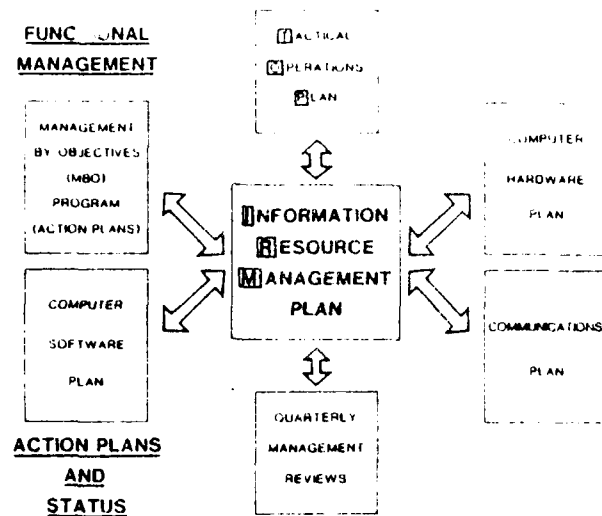
NARRATION: "ONCE OUR HYPOTHETICAL ORGANIZATION HAS APPROVED ITS SBU PLAN, EACH INDIVIDUAL FUNCTIONAL TOP MANAGER IS EXPECTED TO WORK TOGETHER WITH HIS PEERS TO DEVELOP TACTICAL OPERATIONS PLANS FOR THEIR RESPECTIVE ORGANIZATIONS.

"OUR TACTICAL OPERATIONS PLAN IS FOCUSED ON A MUCH SHORTER TIME SPAN THAT THE SBU PLAN, PERHAPS ONLY ONE TO TWO YEARS.

"AT THIS LEVEL OF OUR PLANNING, WE ARE, HOWEVER, PUTTING FORCES INTO MOTION TO EXPEND THE PRECIOUS RESOURCES OF CAPITAL, TIME, HUMAN RESOURCES AND INFORMATION.

"IT IS AT THIS STAGE THAT OUR REQUIREMENTS ANALYSIS AND PLANNING MUST TAKE ON EVEN A MORE STRUCTURED APPROACH TO ASSURE COMMUNICATION AND CONTROL. AT THIS LEVEL, WE ARE MAKING THE SHORTER RANGE DECISIONS THAT WILL IMPACT OVERALL ORGANIZATIONAL PERFORMANCE IN THE NEAR TERM."

**I**NFORMATION **R**ESOURCE **M**ANAGEMENT PLAN



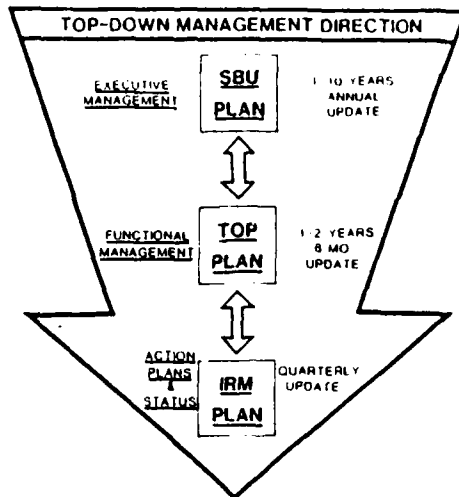
INSTRUCTIONAL OBJECTIVE: To orient executive level management relative to the potential application of ICAM planning and analytical tools to everyday business requirements.

NARRATION: "AT THIS LEVEL OF OUR HYPOTHETICAL ORGANIZATION'S PLANNING, WE ARE DEALING WITH THE "NOW" NEEDS OF OUR OPERATIONAL ENVIRONMENT.

"THE MANAGEMENT OBJECTIVES AND ACTION PLANS ESTABLISHED DURING THE TACTICAL PLANNING PHASE ARE ACTUALLY AT THE STAGE OF IMPLEMENTATION. THERE ARE PROBABLY SENIOR EXECUTIVE QUARTERLY MANAGEMENT REVIEWS BEING CONDUCTED TO ENSURE ADHERENCE TO PLAN AND TO IDENTIFY ANY REQUIRED CORRECTIVE ACTIONS.

"THIS IS THE LEVEL IN OUR FACTORY OF THE FUTURE WHEREIN COMPUTER HARDWARE, SOFTWARE AND COMMUNICATIONS MUST PROVIDE EFFICIENT MANAGEMENT TOOLS FOR MANAGING DAY-TO-DAY COMPUTER INTEGRATION MANUFACTURING (CIM) OPERATIONS."

INFORMATION RESOURCE MANAGEMENT PROGRAM



INSTRUCTIONAL OBJECTIVE: To orient executive level management relative to the potential application of ICAM planning and analytical tools to everyday business requirements.

NARRATION: "IN SUMMARY, OUR HYPOTHETICAL ORGANIZATION HAS INSTALLED A PROVISION FOR CONTINUOUS ITERATIVE "TOP-DOWN" MANAGEMENT DIRECTION AT ALL LEVELS OF OUR FACTORY OF THE FUTURE.

"NOW LET'S TAKE ANOTHER VIEW OF OUR EARLIER DISCUSSION RELATIVE TO A TECHNOLOGY MODERNIZATION (TECH MOD) FRAMEWORK."



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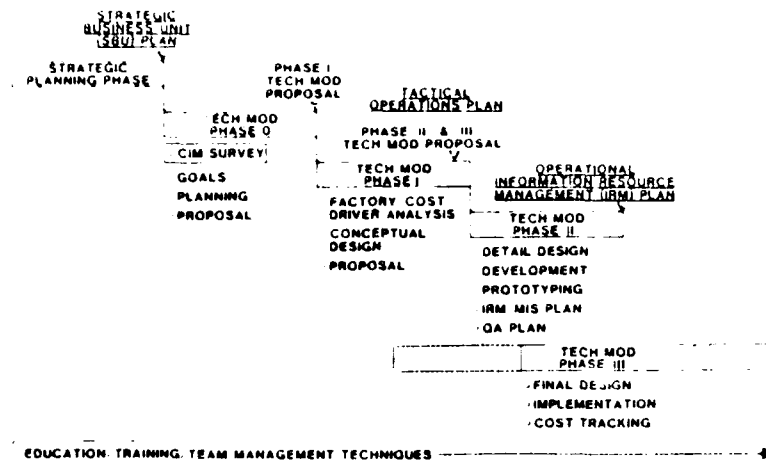
"PROCESSING THESE PROGRAM MANAGEMENT CHANGES THROUGH  
OUR PRIOR PHASE I PLANNING COULD IMPACT OUR TACTICAL  
OPERATIONS PLAN AND INDIVIDUAL TECH MOD PROJECTS.

"CERTAINLY ANY SUCH PHASE I IMPACTS WOULD AFFECT OUR  
OVERALL OPERATIONAL INFORMATION RESOURCE MANAGEMENT  
PLAN.

"IT ALMOST GOES WITHOUT SAYING, THAT WE NOW RECOGNIZE  
THAT WE MUST PLACE SIGNIFICANTLY MORE HUMAN RESOURCE  
MANAGEMENT EMPHASIS ON EDUCATION, TRAINING AND THE  
USE OF TEAM MANAGEMENT TECHNIQUES.

"LET'S TAKE ANOTHER GRAPHIC VIEW OF WHAT WE ARE  
SAYING."

# TECHNOLOGY MODERNIZATION FRAMEWORK



"TOP-DOWN" PROGRAM MANAGEMENT/"BOTTOM-UP" PROJECT IMPLEMENTATION

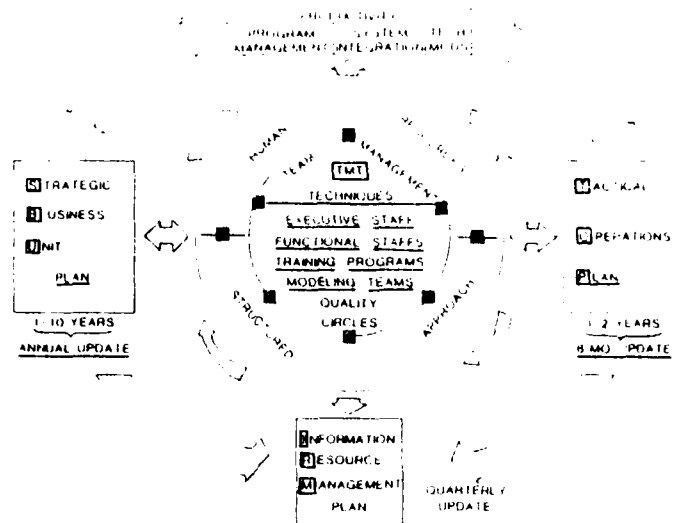
INSTRUCTIONAL OBJECTIVE: To orient executive level management relative to the relationship of structured business planning, structured technology modernization planning, and the use of the structured ICAM planning/analytical tools.

NARRATION: "THE ONLY CHANGES WE HAVE MADE HERE FROM OUR EARLIER "TECHNOLOGY MODERNIZATION FRAMEWORK" DISCUSSION ARE AS FOLLOWS:

"WE RECOGNIZE THE NEED TO INSTITUTE "TOP-DOWN" PROGRAM MANAGEMENT TECHNIQUES WHILE IMPLEMENTING OUR "BOTTOM-UP" TECHNOLOGY MODERNIZATION PROJECTS. THIS "TOP-DOWN" PROGRAM MANAGEMENT MUST BE PERIODICALLY REASSESSED AS THE EXECUTIVE LEVEL BUSINESS PLANS ARE ITERATED.

"WE MUST ALSO RECOGNIZE, IN OUR FACTORY OF THE FUTURE PLANNING, THAT EACH ANNUAL SBU PLAN MAY REVISE PRIOR OUTPUTS OF THE STRATEGIC PLANNING PHASE. THESE CHANGES, COUPLED WITH AN UPDATED COMPUTER INTEGRATED MANUFACTURING (CIM) TECHNOLOGY SURVEY, COULD CAUSE REVISION TO OUR PRIOR TECH MOD PROGRAM PLANNING."

# IRM= "TOP-DOWN" PRODUCTIVITY ENGINEERING



INSTRUCTIONAL OBJECTIVE: To orient executive level management relative to the relationship of structured business planning, structured technology modernization planning, and the use of the structured ICAM planning/analytical tools.

NARRATION: "INFORMATION RESOURCE MANAGEMENT IS KEY TO "TOP-DOWN" PRODUCTIVITY ENGINEERING.

"OUR PRODUCTIVITY PROGRAMS, CONSISTING OF PROGRAM MANAGEMENT, SYSTEM INTEGRATION AND INDIVIDUAL TECHNOLOGY MOD PROJECTS, MUST BE CLOSELY LINKED WITH OUR OVERALL "TOP-DOWN" BUSINESS PLANNING ACTIVITIES.

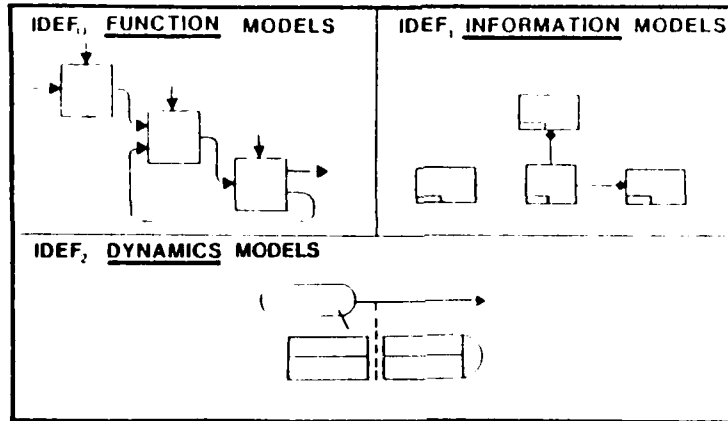
"THIS ITERATIVE PROCESS IS TOTALLY DEPENDENT UPON EFFICIENT INTEGRATION AND UTILIZATION OF OUR HUMAN RESOURCES.

"WE SUBMIT THAT A STRUCTURED BUSINESS PLANNING APPROACH, COUPLED WITH THE STRUCTURED ICAM PLANNING AND ANALYTICAL TOOLS, WILL MATERIALLY ASSIST YOU IN THIS PROCESS.

"AS WE STATED EARLIER, WE RECOGNIZE THAT THIS TEAM MANAGEMENT APPROACH AT ALL LEVELS OF THE ORGANIZATION WILL SOMEWHAT INCREASE "FRONT-END" COSTS AND IMPACT SHORT-TERM COST PERFORMANCE. WE STRONGLY BELIEVE, HOWEVER, THAT THESE NEAR-TERM COSTS WILL BE PAID BACK MANY TIMES OVER IN THE LONG TERM BY MUCH IMPROVED RETURN OF INVESTMENT (ROI)."

## ICAM DEFINITION -- IDEF

SYSTEMATIC APPLICATION of COMPUTER TECHNOLOGY



INSTRUCTIONAL OBJECTIVE: To summarize and gain executive management acceptance of ICAM IDEF planning and analytical tools.

NARRATION: 'AS A RESULT OF HIS ORGANIZATION'S CIM SURVEY, THE GENERAL MANAGER OF THE FACTORY OF THE FUTURE SHOULD FIND A CATALOG OF PRODUCT AND PROCESS TECHNOLOGIES IN HIS "MODERNIZATION KIT" THAT WILL BE AVAILABLE IN THE 1985 - 1990 TIME FRAME.

"THESE TECHNOLOGIES MAY INVOLVE EXOTIC PROCESSES AND HIGH-SPEED INTEGRATED CIRCUITS, NEW METALS AND COMPOSITES, MOST OF THEM PROBABLY UTILIZING SOPHISTICATED COMPUTER CONTROL DEVICES.

"AN ABUNDANCE OF TECHNOLOGIES ARE AVAILABLE TODAY IN THE LABORATORY THAT HAVE NOT YET BEEN ASSIMILATED INTO MANUFACTURING. THESE LEADING-EDGE CAPABILITIES ARE EASIER TO CONCEIVE AND DESIGN THAN TO IMPLEMENT IN THE FACTORY OF THE FUTURE.

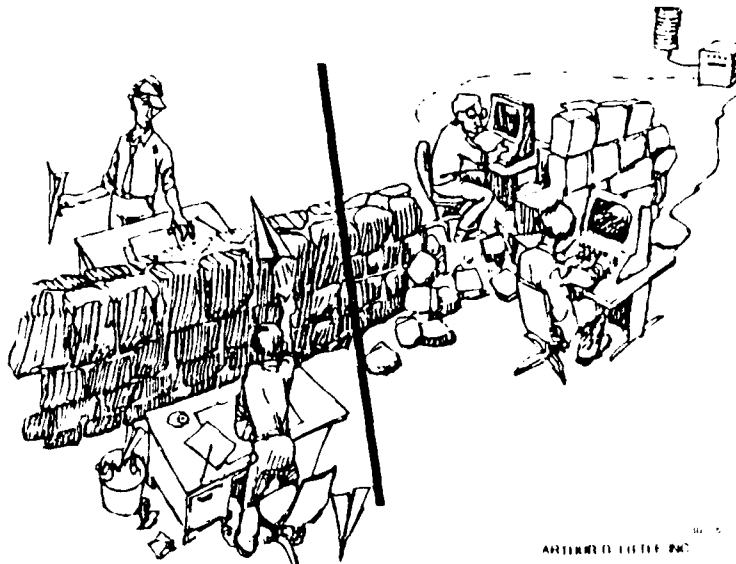
"THE STRATEGIC PLANNING THAT DESCRIBES THE MARKET-PLACE AND THE MARKET NEEDS WILL DETERMINE THE REQUIREMENTS FOR IMPLEMENTING SPECIFIC NEW TECHNOLOGIES. CONSIDERATION OF HUMAN RESOURCE MANAGEMENT REQUIREMENTS WILL AID US IN IMPLEMENTING THESE TECHNOLOGIES.

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8 September 1983

"AGAIN. IT IS THE OPINION OF THE ICAM PROGRAM THAT  
THE SYSTEMATIC APPLICATION OF COMPUTER TECHNOLOGY  
UTILIZING THE ICAM IDEF PLANNING AND ANALYTICAL TOOLS  
WILL FACILITATE THIS DIFFICULT TRANSITION.

## THE OLD WAY

## THE NEW WAY



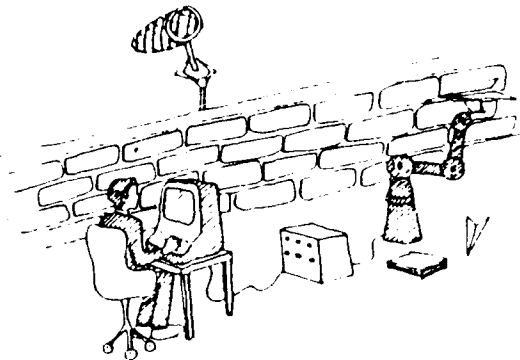
INSTRUCTIONAL OBJECTIVE: To orient executive management relative to the need to exercise caution in implementing new technology.

NARRATION: "IN CLOSING, WE BORROWED THIS CARTOON FROM ARTHUR D. LITTLE TO EXPRESS A BIT OF OPTIMISM RELATIVE TO OUR INDUSTRIAL FUTURE.

"COMPUTER TECHNOLOGY, SYSTEMATICALLY IMPLEMENTED UTILIZING A WELL DEFINED STRUCTURED APPROACH, CAN PROVIDE INTEGRATED DATABASES WHICH WILL TEAR DOWN THE TRADITIONAL ORGANIZATIONAL WALLS IN OUR ORGANIZATIONS.

"WE MUST, HOWEVER, EXERCISE CAUTION ---"

## THE WRONG WAY



INSTRUCTIONAL OBJECTIVE: To orient executive management relative to the need to exercise caution in implementing new technology.

NARRATION: "UNLESS EXECUTIVE LEVEL MANAGEMENT BECOMES INVOLVED AND PROVIDES SPECIFIC "TOP-DOWN" INTEGRATION DIRECTION DURING MANUFACTURING TECHNOLOGY MODERNIZATION PROJECT PLANNING ---- THIS MAY BE OUR END RESULT.

## SUMMARY

---

- THE PROBLEM
  - U.S. PRODUCTIVITY PERFORMANCE
  - U.S. INDUSTRY AUTOMATION TECHNOLOGY
- THE SOLUTION
  - INTEGRATED COMPUTER AIDED MANUFACTURING/TECH MODS
  - ICAM ANALYTICAL/PLANNING TOOLS
  - INTEGRATED STRATEGIC PLANNING & INFORMATION RESOURCE MANAGEMENT (IRM)

INSTRUCTIONAL OBJECTIVE: To summarize the Executive Overview presentation.

-----

NARRATION: "IN SUMMARY, WE HAVE DISCUSSED THE PROBLEM WITH U.S. PRODUCTIVITY PERFORMANCE AND THE DANGER OF UNINTEGRATED IMPLEMENTATION OF AVAILABLE TECHNOLOGY.

"WE HOPE THAT YOU WILL AGREE WITH US THAT THE SOLUTION MAY WELL BE INTEGRATED COMPUTER-AIDED MANUFACTURING BASED UPON WELL PLANNED TECHNOLOGY MODERNIZATION PROGRAMS.

"IT IS ALSO HOPED THAT YOU WILL ALSO CONCUR THAT THE ICAM PROGRAM'S ANALYTICAL AND PLANNING TOOLS WILL BE OF BENEFIT TO YOUR ORGANIZATION AND TO OTHERS THROUGHOUT INDUSTRY. WE BELIEVE THE USE OF ICAM IDEF METHODOLOGIES AND THE RESULTING ARCHITECTURES WILL FACILITATE MANY OF YOUR COMMUNICATION PROBLEMS.

"WE ALSO HOPE THAT OUR LOOK-AHEAD TO THE FACTORY OF THE FUTURE WILL PROVIDE YOU FOR FOOD FOR THOUGHT RELATIVE TO YOUR OWN OPERATION. PERHAPS THE LINKING OF STRATEGIC PLANNING AND INFORMATION RESOURCE MANAGEMENT UTILIZING A "TOP-DOWN" STRUCTURED APPROACH WILL HELP US TURN U.S. INDUSTRY AROUND.

"WE THANK YOU FOR YOUR TIME AND CONSIDERATE ATTENTION DURING THIS PRESENTATION. ARE THERE ANY FURTHER QUESTIONS"?



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INTEGRATED COMPUTER-AIDED MANUFACTURING (ICAM)  
ARCHITECTURE PART 3 VOLUME (U) SOFTECH INC WALTHAM MA  
A W SNODGRASS SEP 83 1080-37

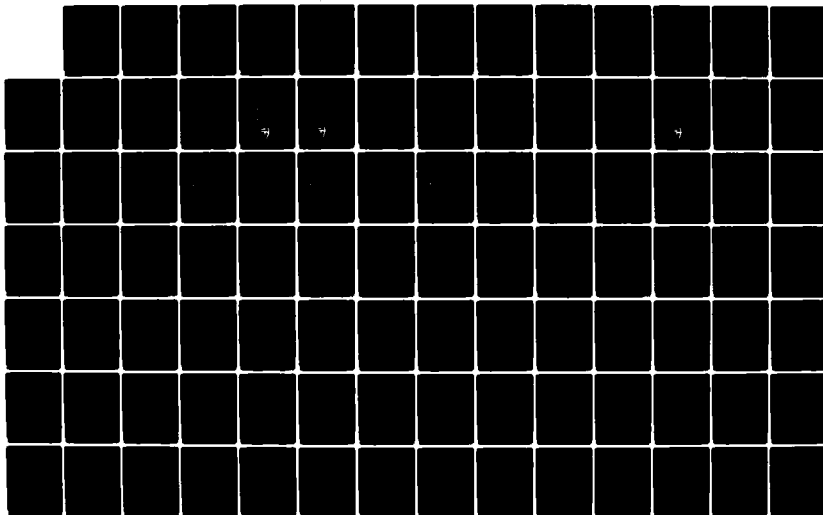
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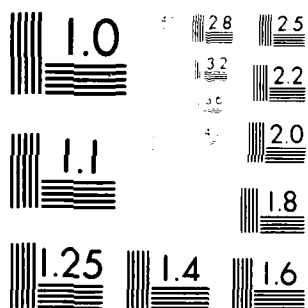
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U.S. GOVERNMENT PRINTING OFFICE: 1963

## 2.3 Technology Transfer Practitioner's Presentation Manual

### FOREWORD

This Presentation Manual is provided to help teach an overview of the U.S. Air Force's Modernization (TECH MOD) Program's use of related IDEF applications, concepts, procedures. It also covers the use of the resulting architecture and planning in controlling these Technology Modernization Programs to upgrade the U.S. industrial base.

This Presentation Manual provides the instructor with the presentation materials required to actually conduct the course. The instructor also will have received a "Train the Trainers" Manual which provides a step-by-step process, section-by-section, dealing with the concepts and procedures of IDEF0 function modeling, including reading, authoring, commenting on, and iterating IDEF0 function models.

#### 2.3.1 Introduction

This is an instructor's Presentation Manual intended to aid those teaching an overview of the Air Force Manufacturing Technology Modernization (TECH MOD) Program's use of related ICAM IDEF Function Modeling Methodology. The instructor's Practitioner's "Train the Trainers" Manual provides the elements and an order of presentation needed in teaching. The developing of style is left to the individual instructor.

This instructor's Presentation Manual consist of a guide for conducting and presenting a practitioner's level briefing. The instructor's Practitioner's "Train the Trainers" Manual provides a step-by-step text, containing the objectives and procedures to be covered, concepts, and a suggested narration.

The course materials are presented in a standardized format, divided into four sections. Each page is composed of a copy of the foil, the instructional objective that must be covered with that foil, and a suggested narration that may be followed until individual styles can be developed.

It must be made clear from the start that the ICAM Definition Language (IDEF) requires that both functions and data necessary to carry out a process be modeled.

The IDEF0 Function Modeling Methodology concerns itself with the modeling of functions along with the data those functions employ.

The IDEF0 Function Model is composed of diagrams, text, and glossary.

Both Authoring and Commenting roles and responsibilities of IDEF0 Function Models are required for full development of each Function Model, because of the iterative nature of the IDEF0 methodology. This IDEF0 Training Course discusses Authoring Concepts and Procedures as well as Commenting Concepts and Procedures, respectively.

Overall planning for and conducting of actual training sessions is almost as critical to accomplishing participant learning objectives as the course presentation material. Attention must be given to planning for presentation set-up, pre-presentation, presentation, and post-presentation activities.

#### 2.3.1.1 Presentation Set-Up

##### 2.3.1.1.1 Audio/Visual Equipment:

- a) Overhead vue foil projector
- b) 35mm projector (if slides are used)

##### 2.3.1.1.2 Audio/Visual Aids:

- a) Overhead transparencies
- b) 35mm color transparencies (when slides are used)
- c) Training materials (handouts and/or manuals)

##### 2.3.1.1.3 Room Set-up:

Everyone must be in hearing and seeing distance of the presentation.

REMEMBER: The best instructional program is no good if you can't hear and see it!

##### 2.3.1.2 Pre-Presentation

- Review all training materials beforehand and be familiar with them.
- Make sure room, equipment, and materials are all in order and ready to go when you are.

REMEMBER: Prior planning prevents poor performance!

- Set up audio/visual equipment.
- Get audio/visual aids ready for presentation.

- a) Make sure all overhead transparencies are in their order of presentation.
- c) Make sure all 35mm color transparencies (when slides are used) are in their order of presentation and that they are all placed in carousel right-reading, (a slide in backwards or upside down can throw your whole presentation off kilter).
- Handout training materials:
  - a) IDEF0 Function Modeling Manual (Vol. IV - AFWAL-TR-81-4023)
  - b) Composite Function Model of "Manufacture Product" (MFGØ - Vol. VII - AFWAL-TR-81-4023)
  - c) MFGØ Node Tree
  - d) DESØ Node Tree
  - e) IDEF Kit Cover Sheet
  - f) IDEF Forms
  - g) IDEF Templates
  - h) Copies of Presentation Materials (Handed out section by section as applicable)

#### 2.3.1.3 Presentation

- Give introduction
  - a) Include purpose and viewpoint of presentation.
  - b) Set atmosphere conducive to learning.
- Go through training materials step-by-step.
- Use peer cross-referencing method to check for understanding.

##### PEER CROSS-REFERENCING METHOD

- a) Ask who understands the point you've just presented.
- b) Ask who isn't clear about it.
- c) Ask if anyone who understands the point can explain it to those who don't.

NOTE: If you don't get any takers, you must explain it over again, if possible, in different terms.

- REMEMBER:

Just because you've presented the material doesn't mean that everyone has understood it.

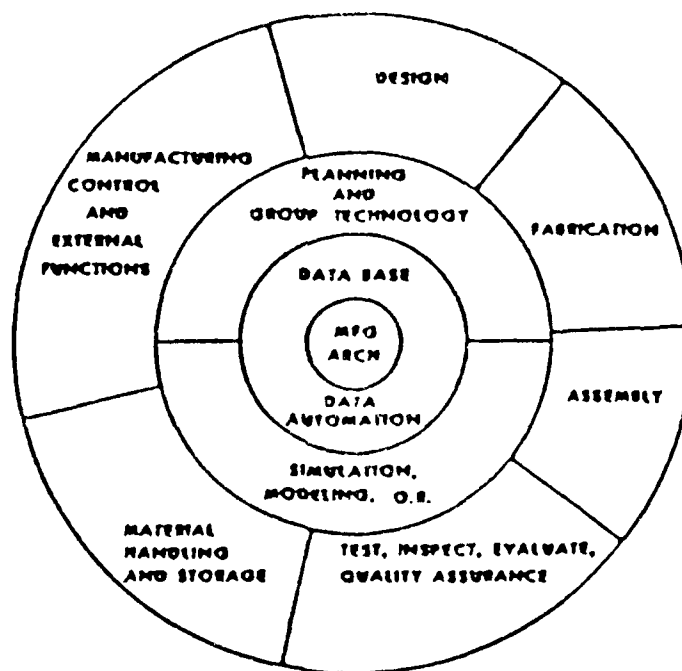
#### 2.3.1.4 Post Presentation

- Try not to leave any question unanswered. If you don't know, find out, and write or call with the answer.
- At some time, a sheet could be filled out with the name, organization, department, phone number, etc. of those attending. Get sheet typed and make copies to give to everyone. Use for:
  - historical record
  - contact sheet.

#### 2.3.2 ICAM IDEF/Architecture

# USAF MANUFACTURING TECHNOLOGY PROGRAM

A MANUFACTURING TECHNOLOGY MODERNIZATION  
PROGRAM CONCEPT FOR  
INTEGRATED COMPUTER-AIDED MANUFACTURING (ICAM)  
IDEF/ARCHITECTURE METHODOLOGY



PRACTITIONER'S PRESENTATION MANUAL

# **IDEF → ARCHITECTURE**

---

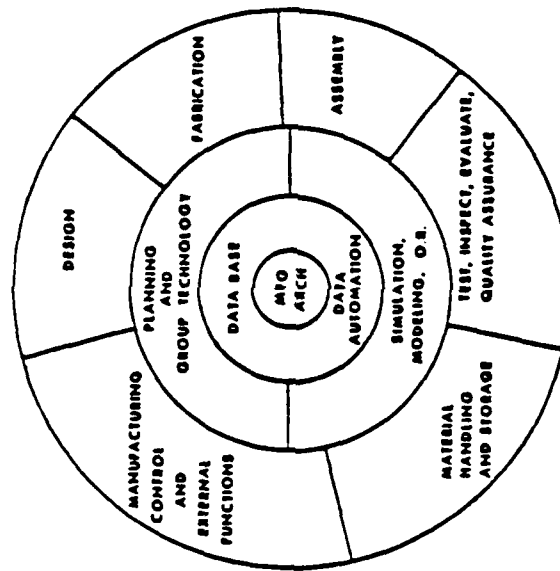
- **WHAT IS ICAM ?**
- **WHAT IS IDEF ?**
- **HOW DOES IDEF RELATE  
TO ARCHITECTURE ?**



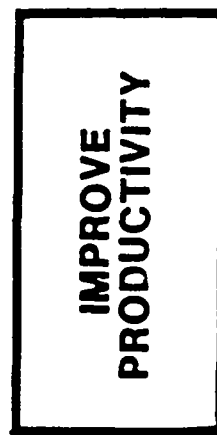
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8 September 1983

# WHAT IS ICAM?

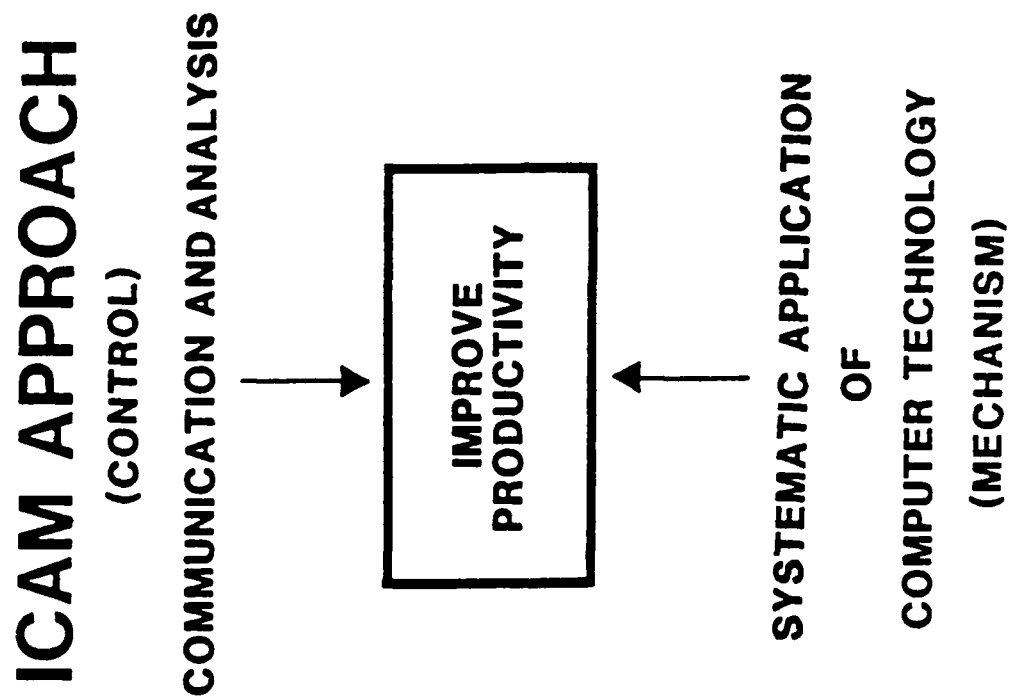
# ICAM INTEGRATED COMPUTER-AIDED MANUFACTURING



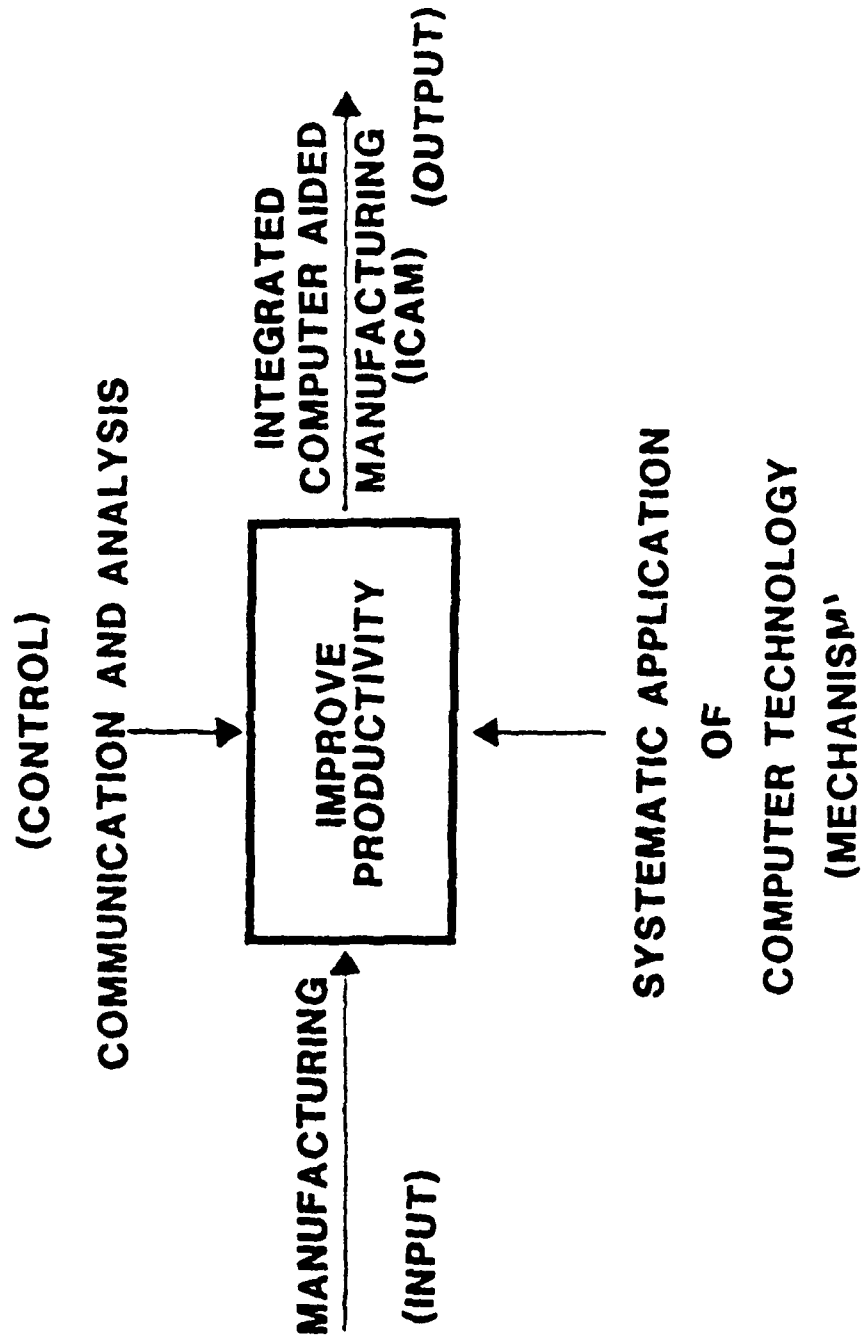
# PURPOSE OF ICAM



SYSTEMATIC APPLICATION  
OF  
COMPUTER TECHNOLOGY  
(MECHANISM)

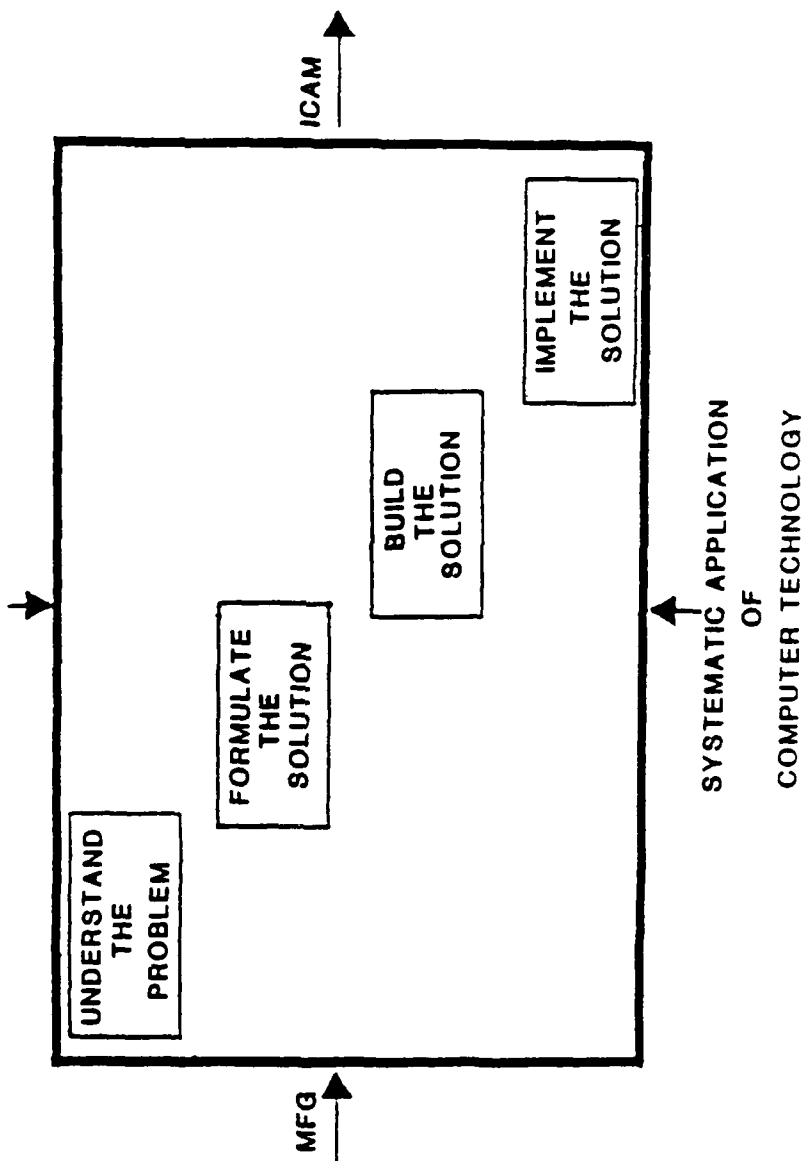


# OBJECTIVE OF ICAM



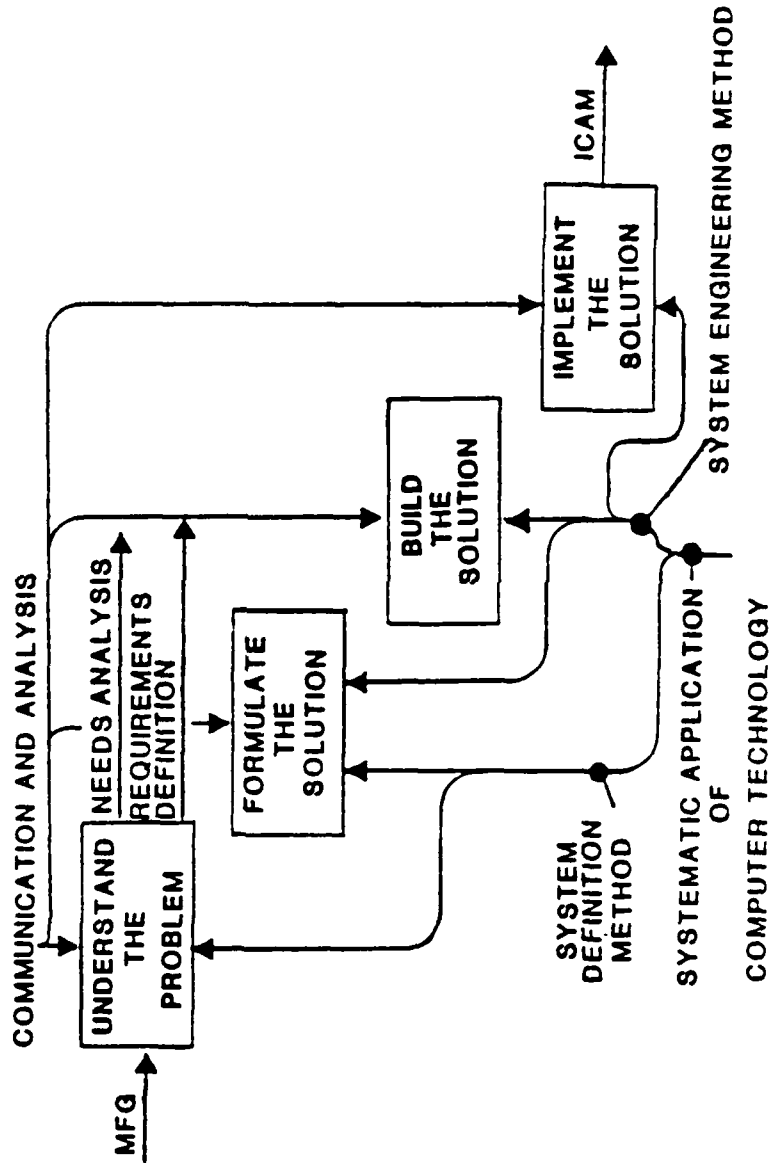
# IMPROVE PRODUCTIVITY

## COMMUNICATION AND ANALYSIS

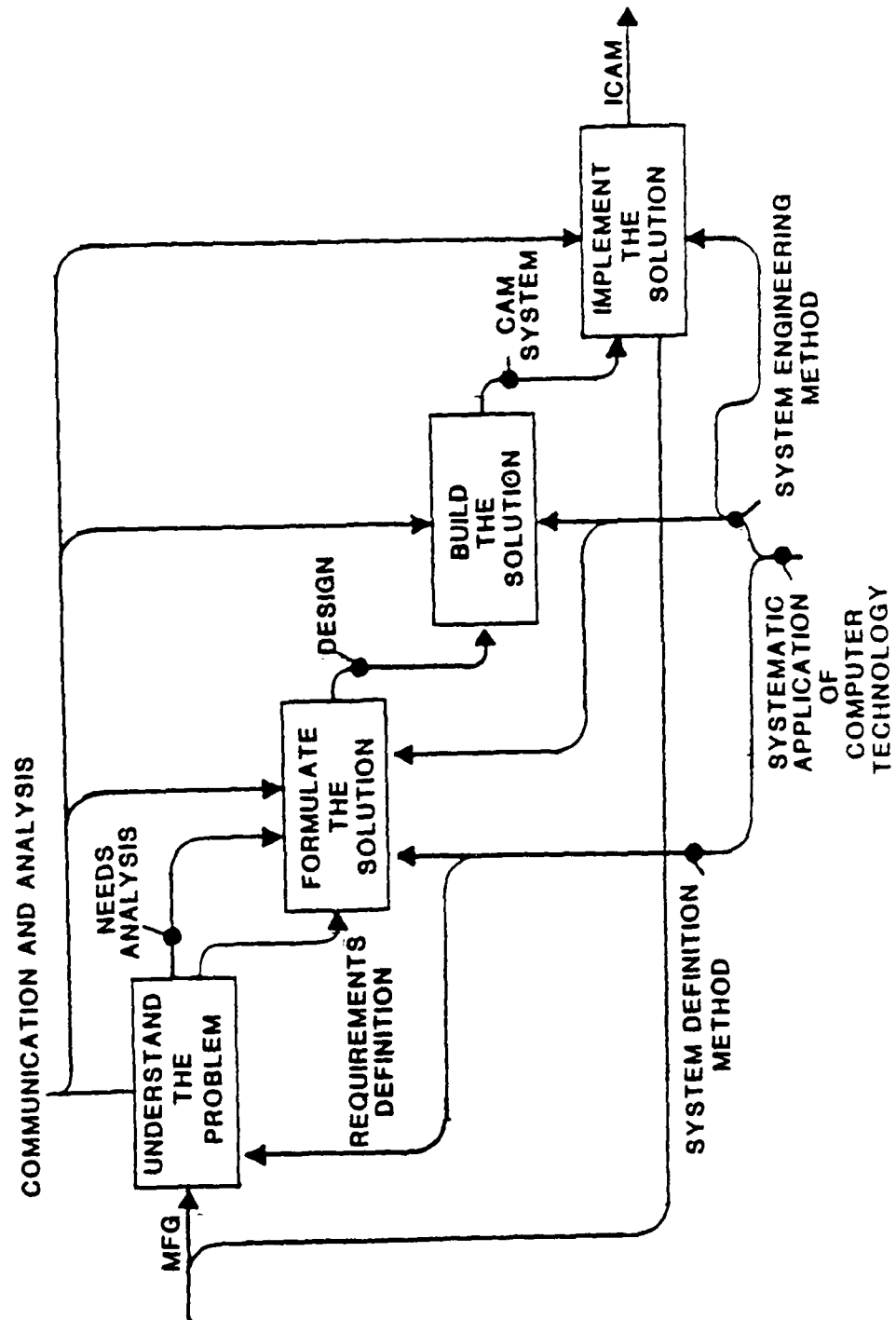


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# IMPROVE PRODUCTIVITY



# IMPROVE PRODUCTIVITY



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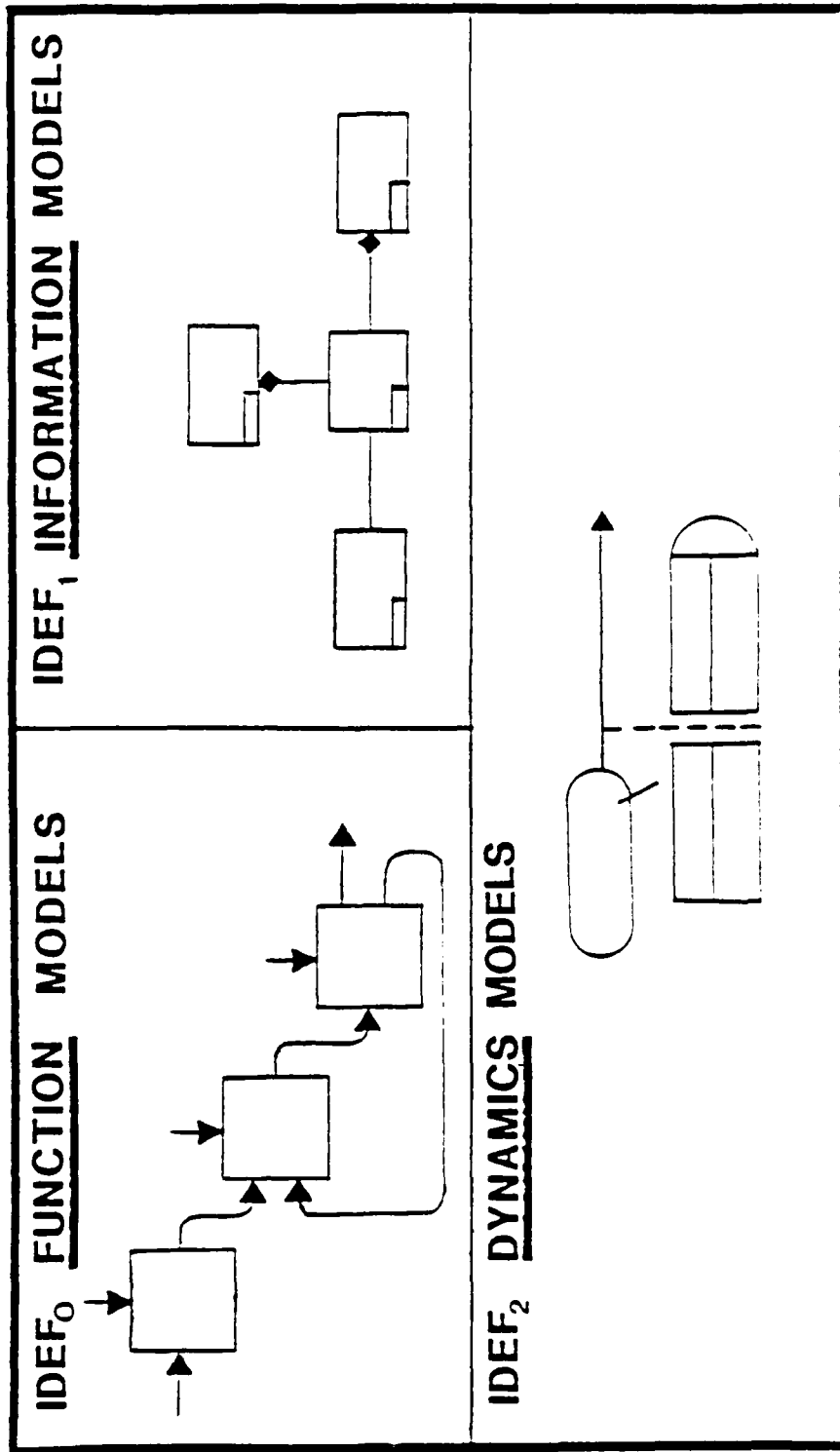


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# WHAT IS IDEF?

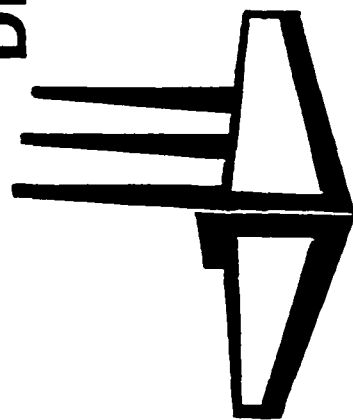
# ICAM DEFINITION → IDEF

## SYSTEMATIC APPLICATION of COMPUTER TECHNOLOGY

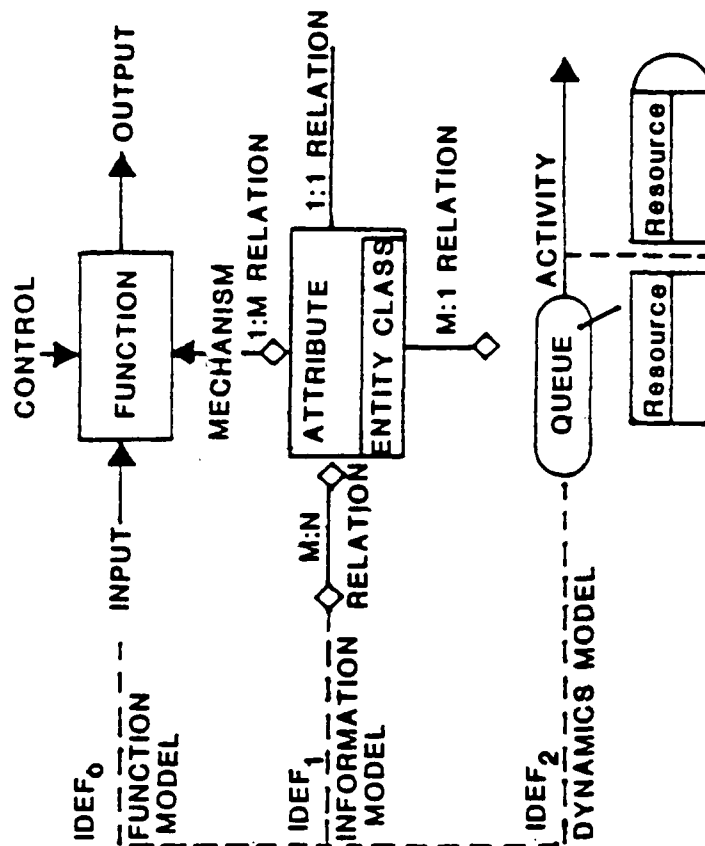


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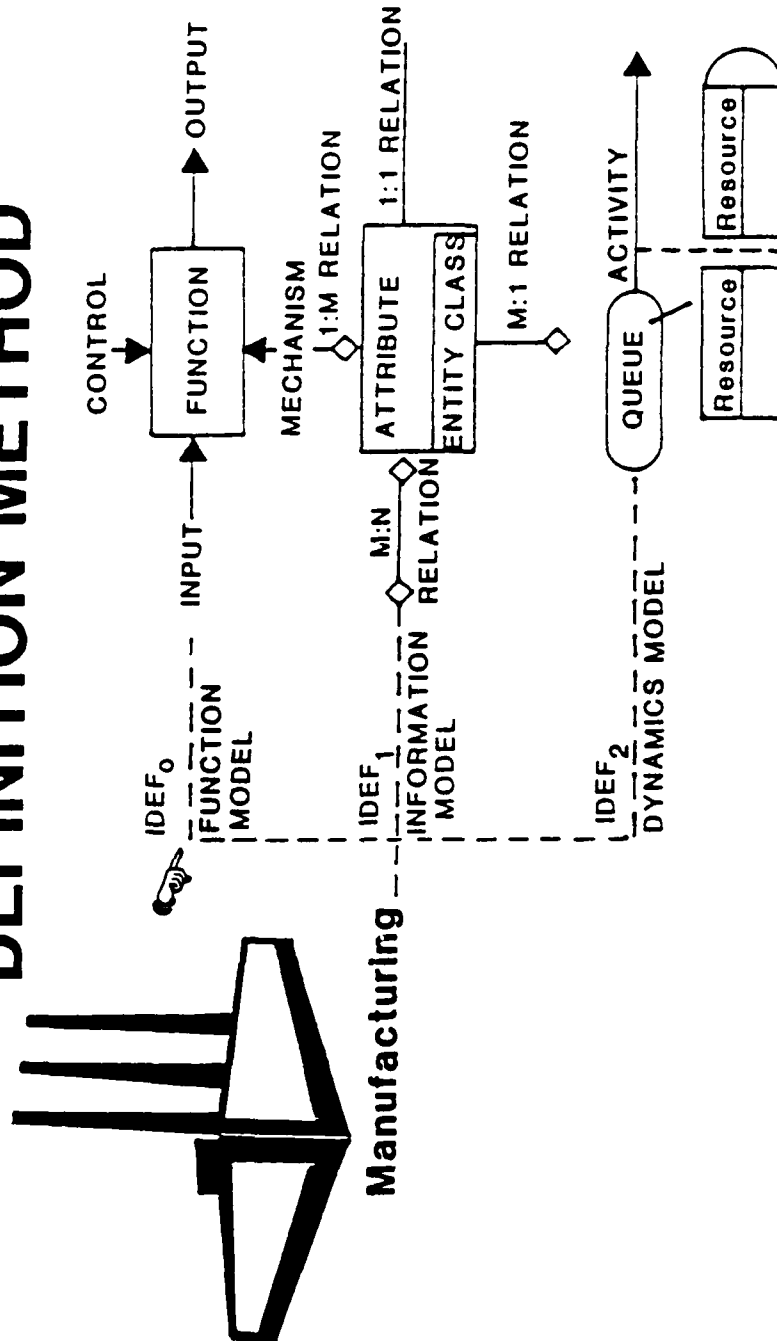
# IDEF - A SYSTEM DEFINITION METHOD



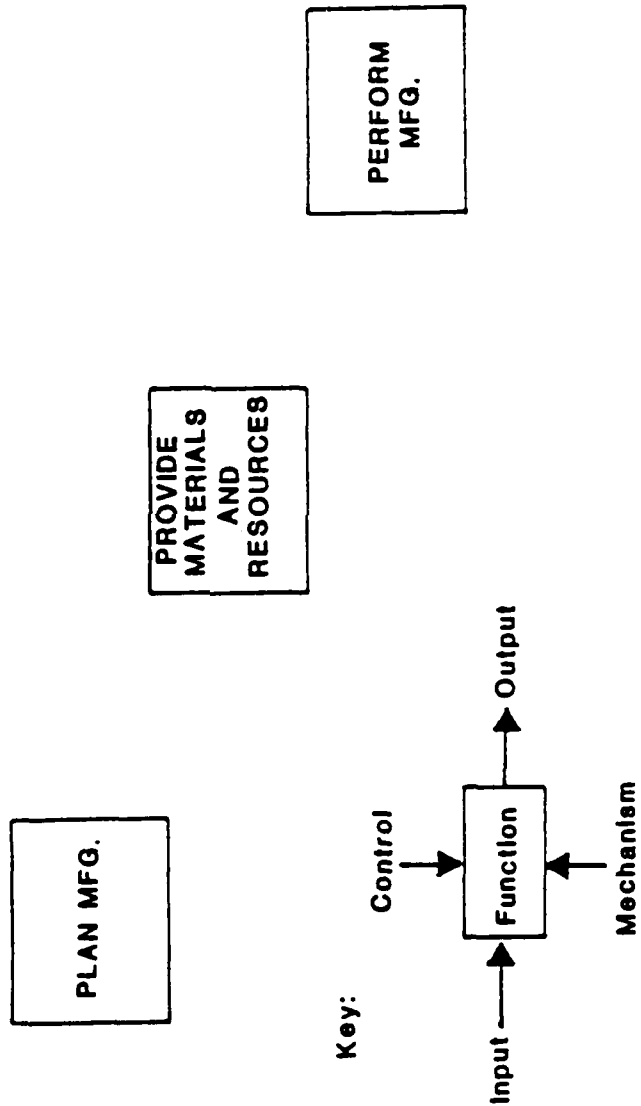
Manufacturing



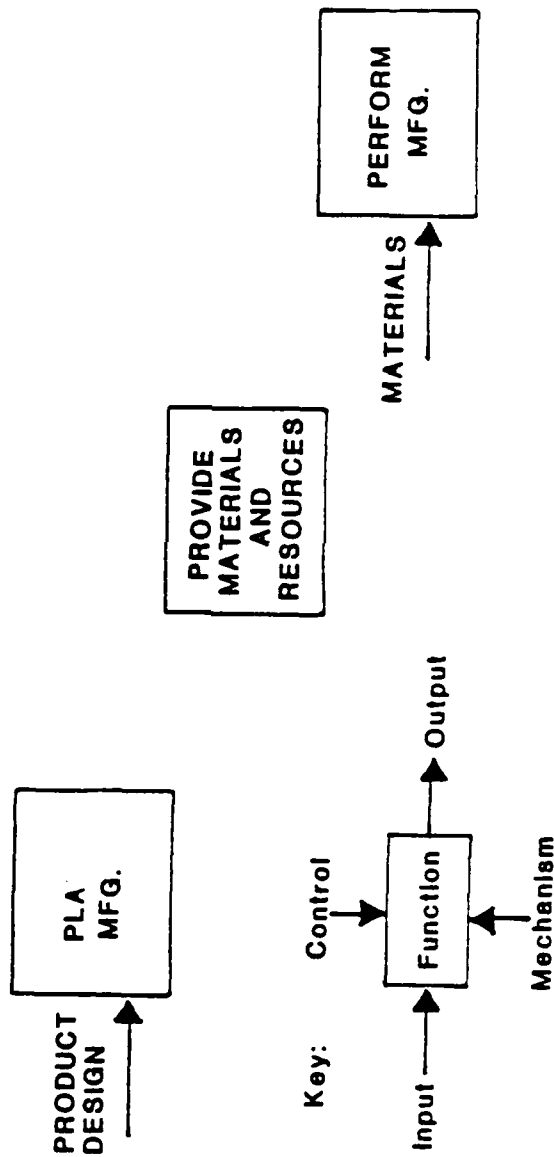
# IDEF - A SYSTEM DEFINITION METHOD



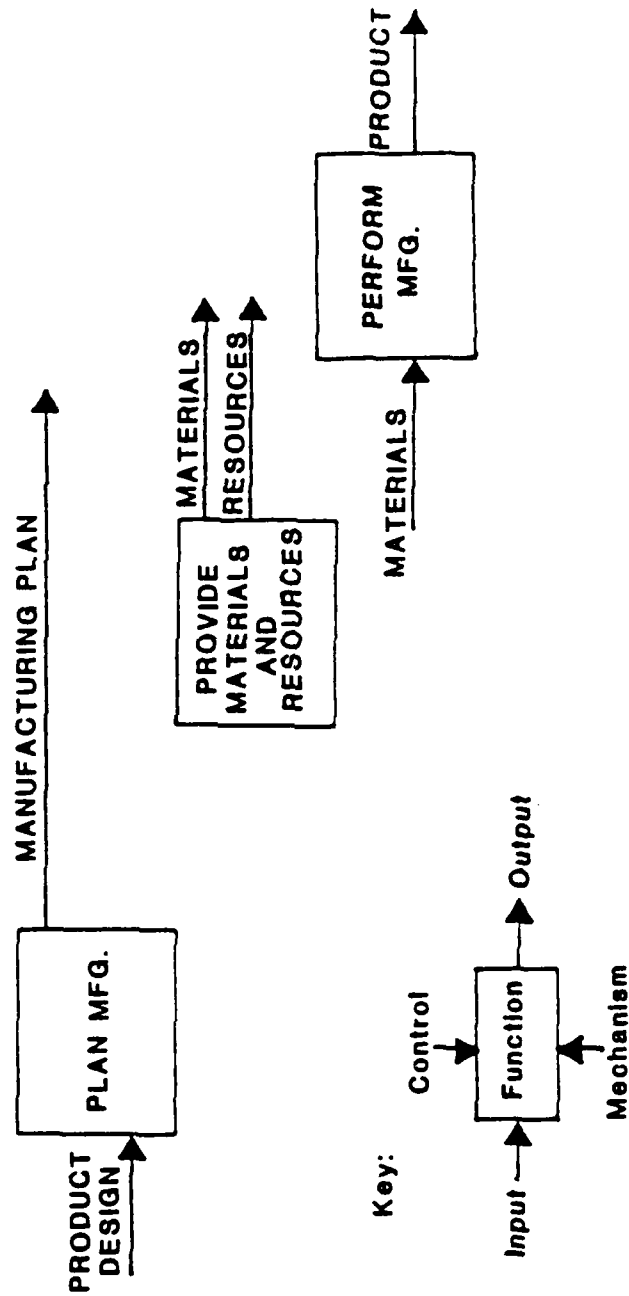
# IDEF<sub>0</sub> → FUNCTION MODEL



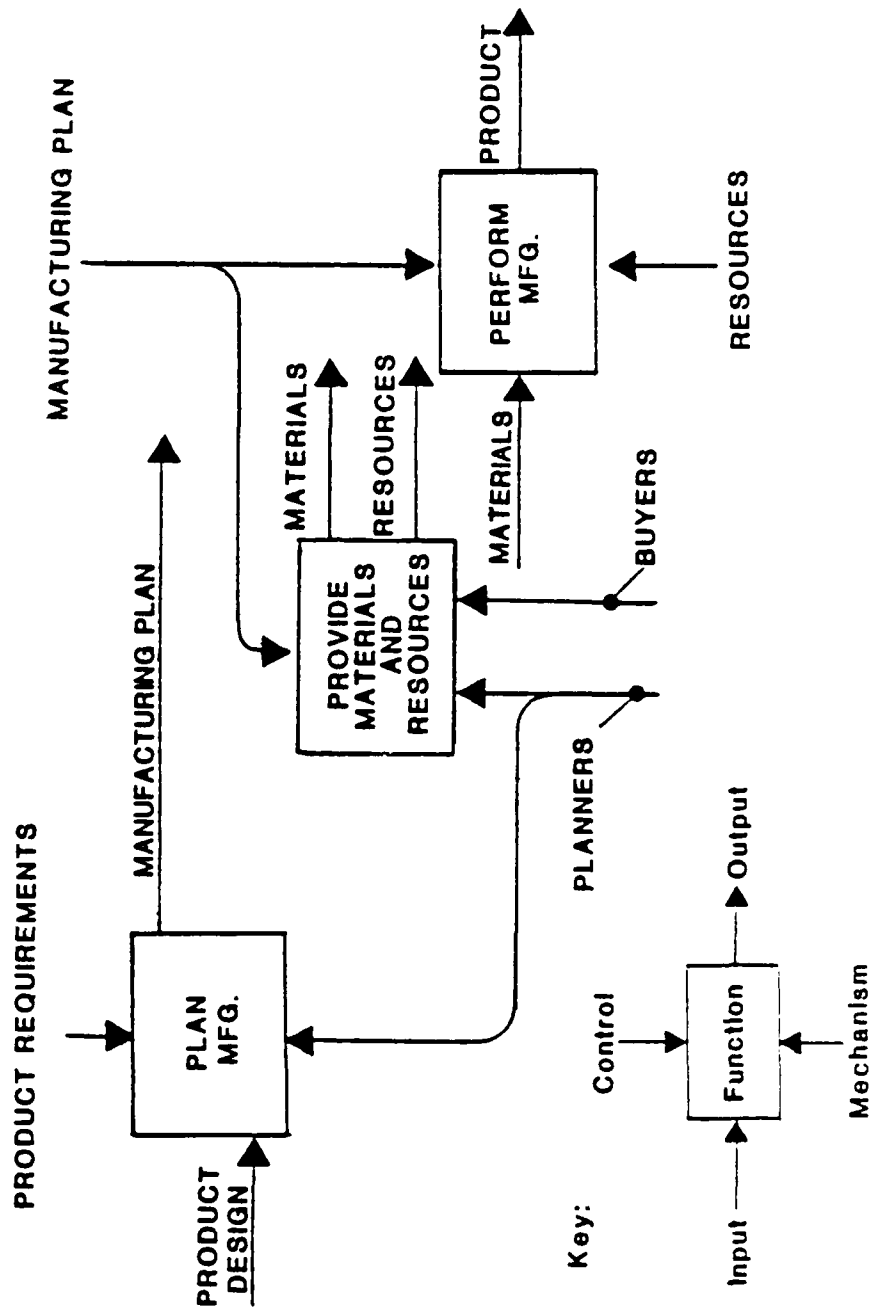
# IDEF<sub>0</sub> → FUNCTION MODEL



# IDEF<sub>0</sub> → FUNCTION MODEL

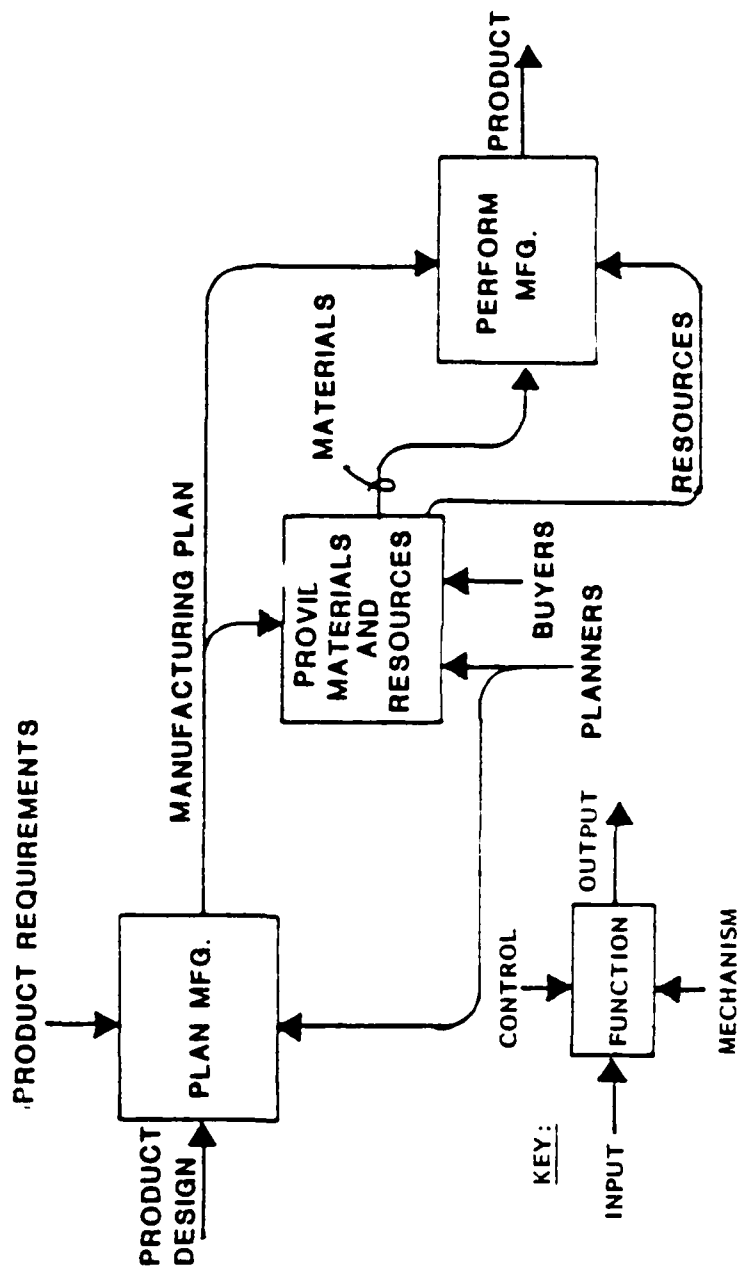


# IDEF<sub>0</sub> → FUNCTION MODEL

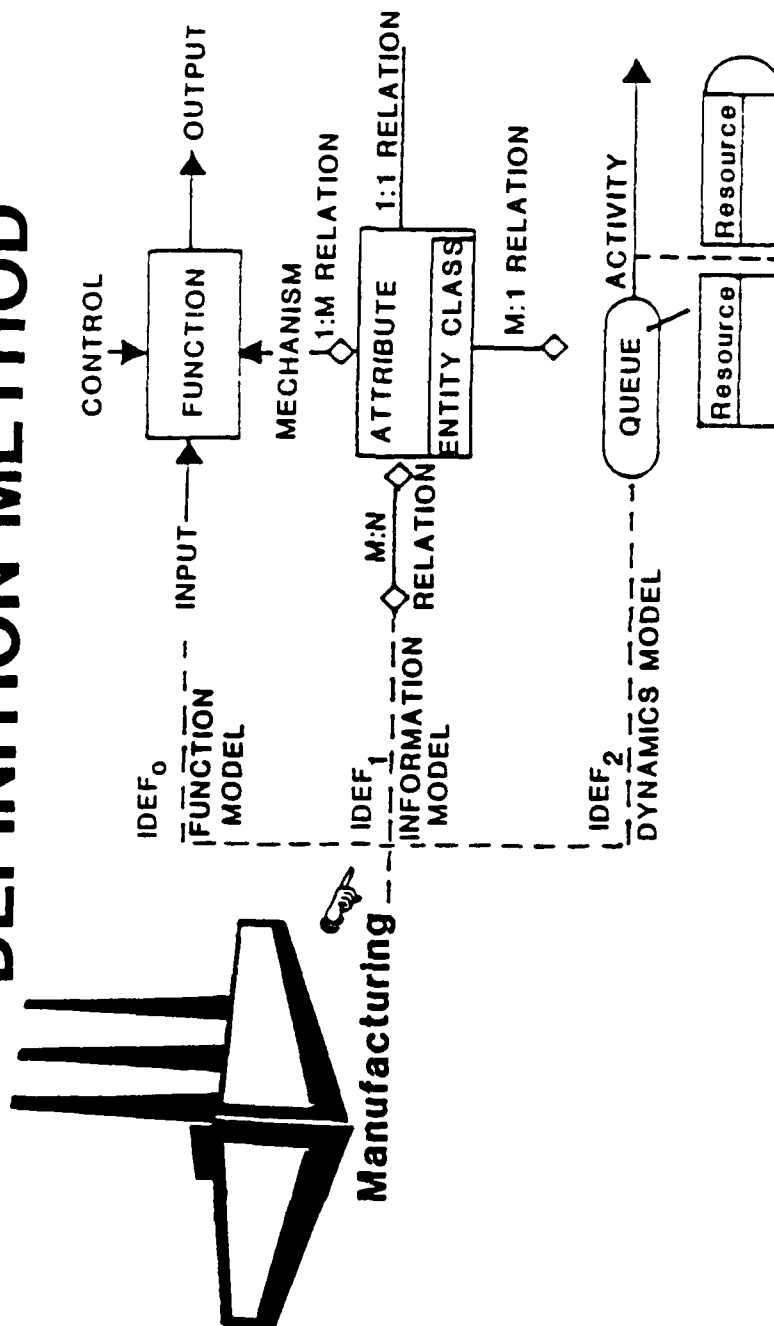




# IDEF<sub>0</sub> → FUNCTION MODEL

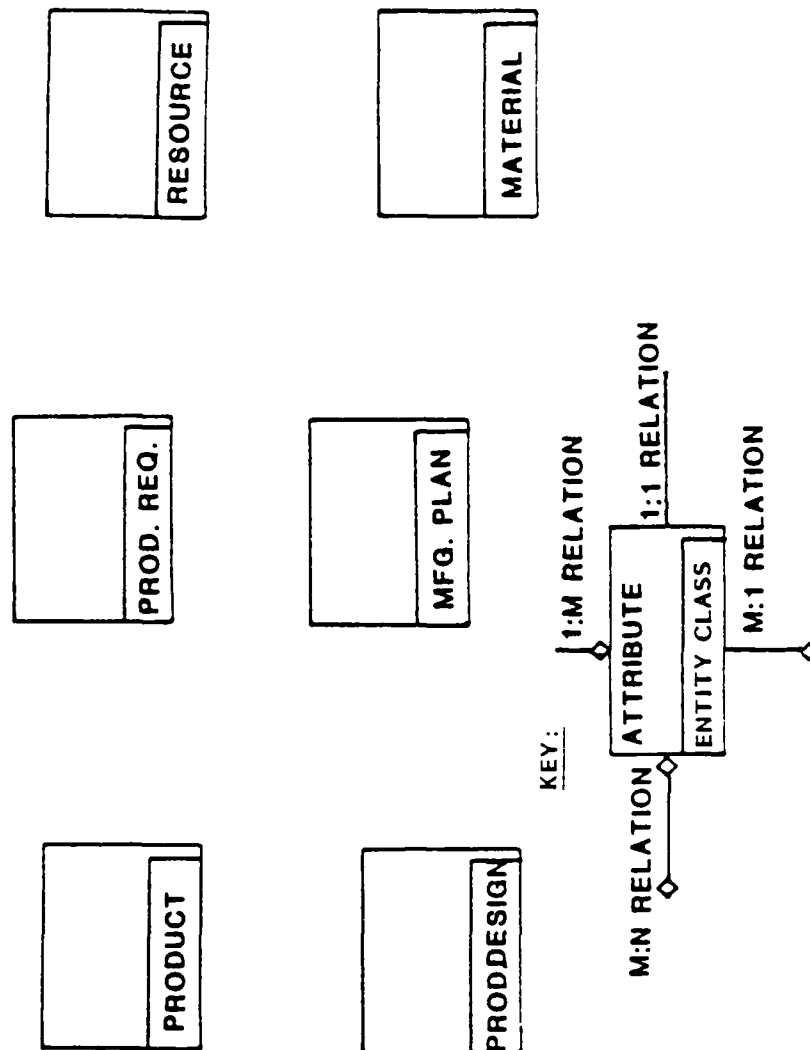


# IDEF - A SYSTEM DEFINITION METHOD

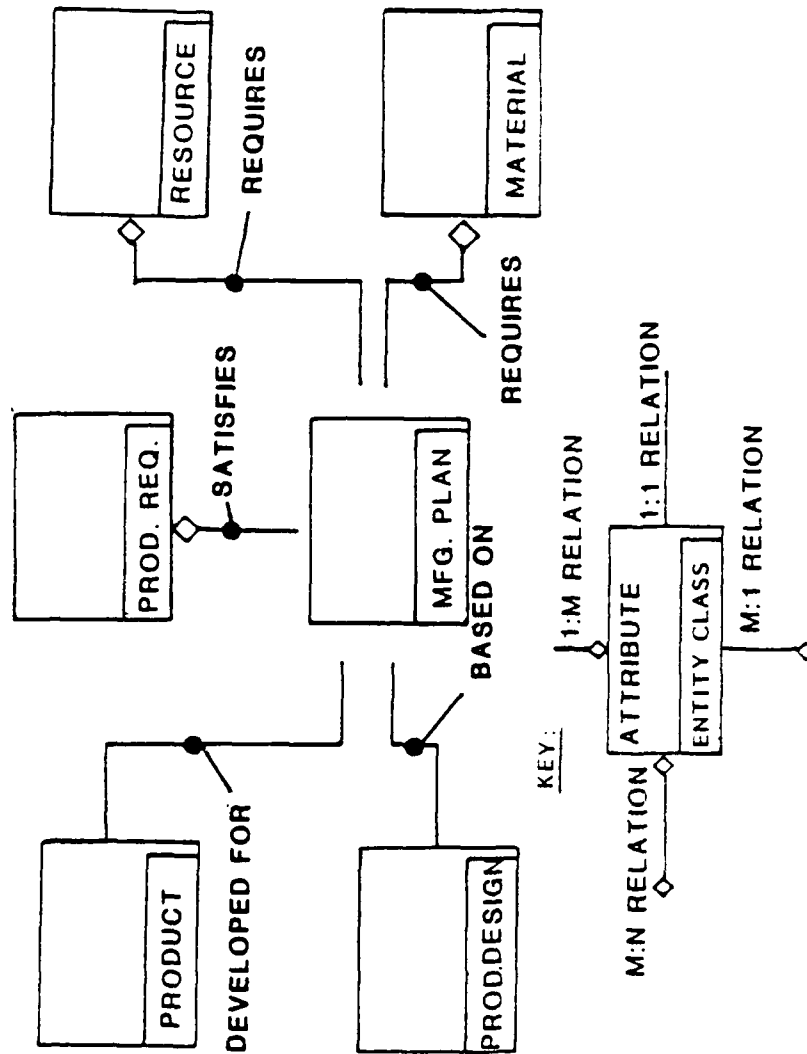


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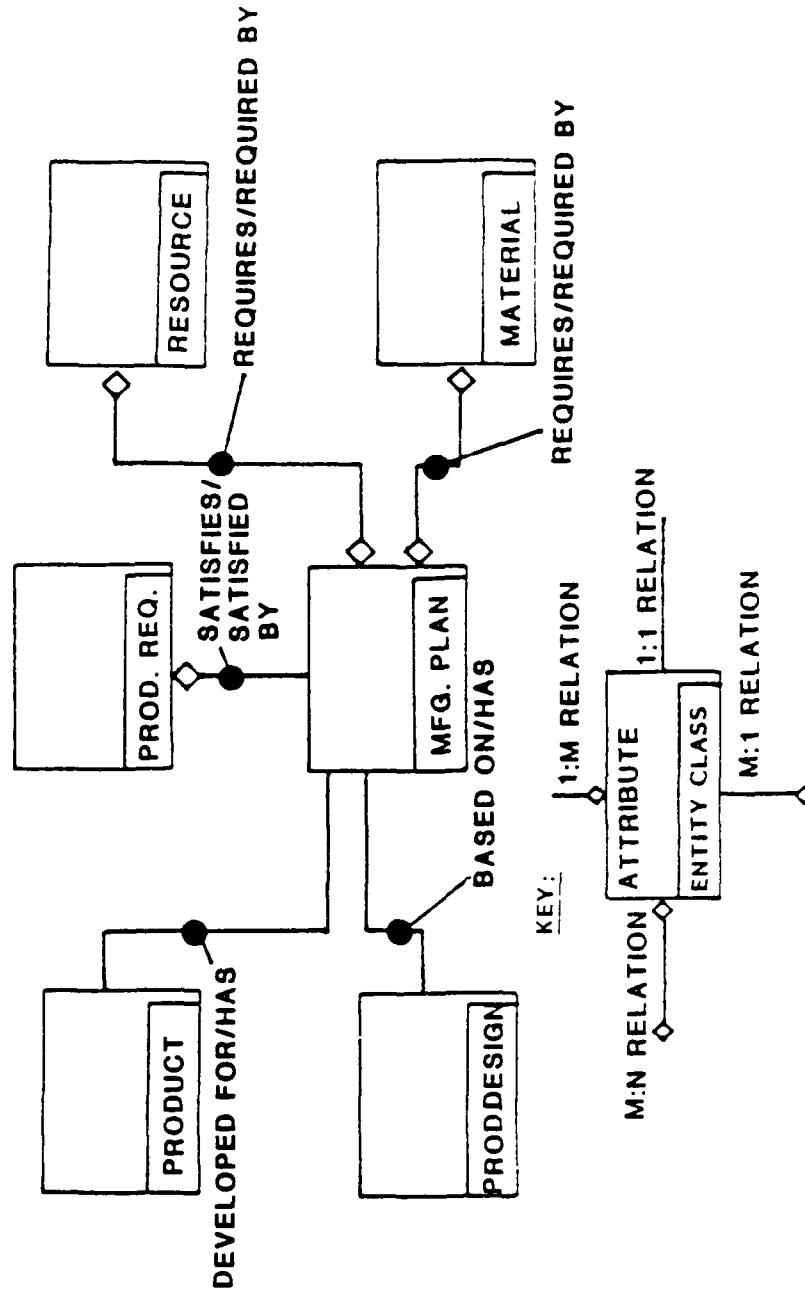
# IDEF<sub>1</sub> → INFORMATION MODEL



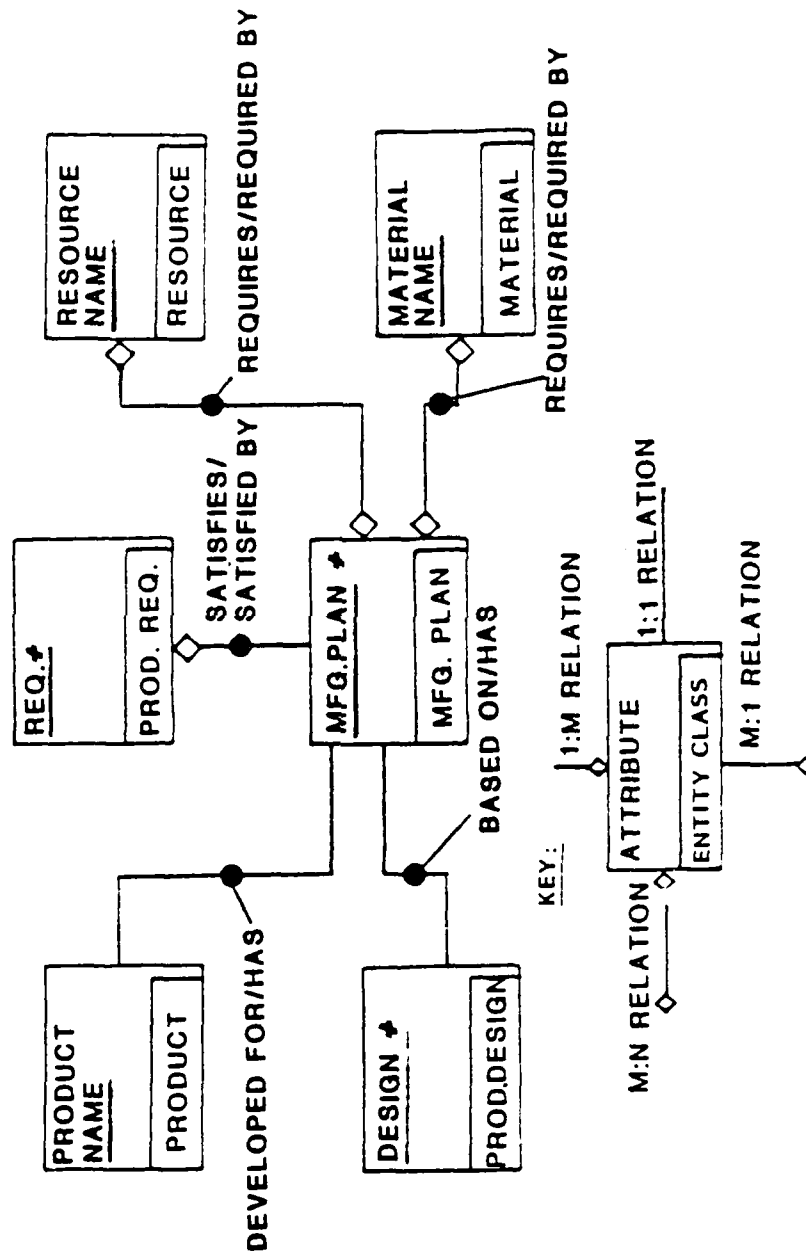
# IDEF<sub>1</sub> → INFORMATION MODEL



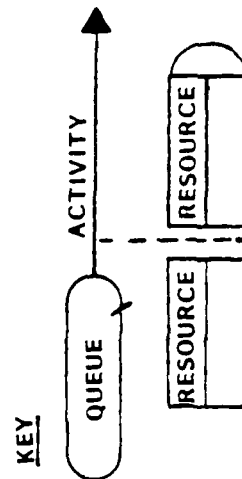
# IDEF<sub>1</sub> INFORMATION MODEL



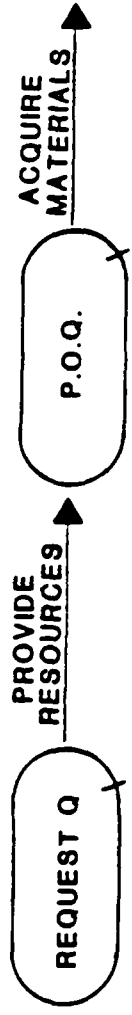
# IDEF<sub>1</sub> INFORMATION MODEL



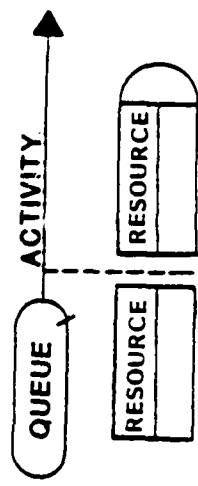
# IDEF<sub>2</sub> → DYNAMICS MODEL



# IDEF<sub>2</sub> → DYNAMICS MODEL

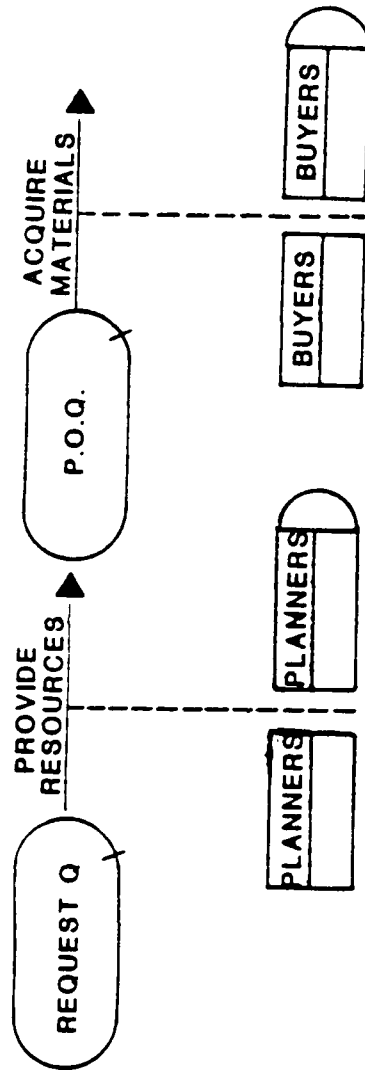


## KEY

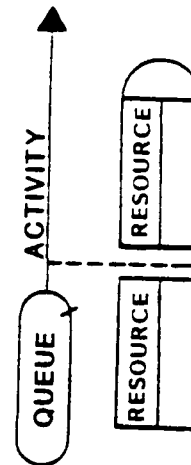




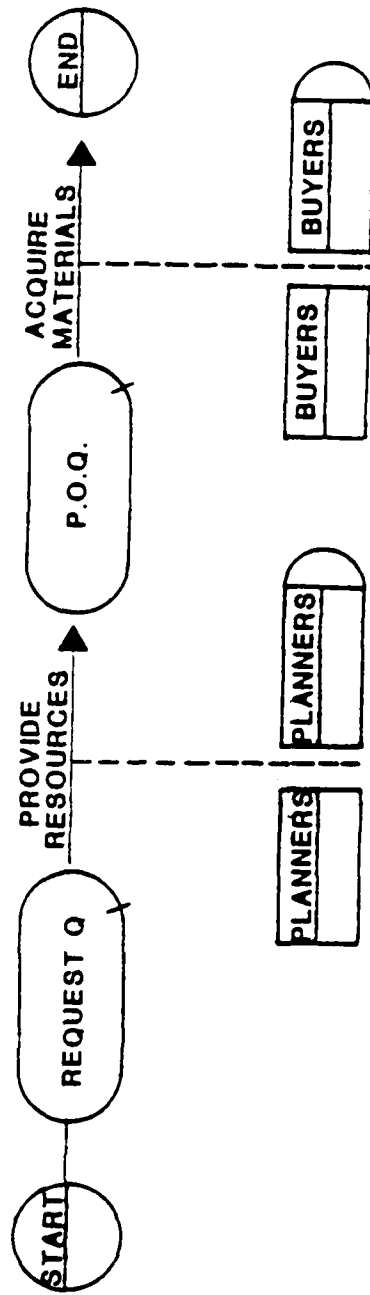
# IDEF<sub>2</sub> → DYNAMICS MODEL



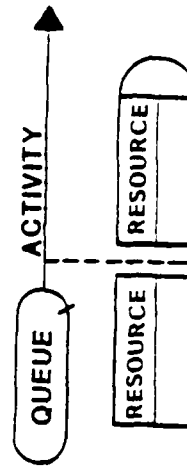
KEY



# IDEF<sub>2</sub> → DYNAMICS MODEL



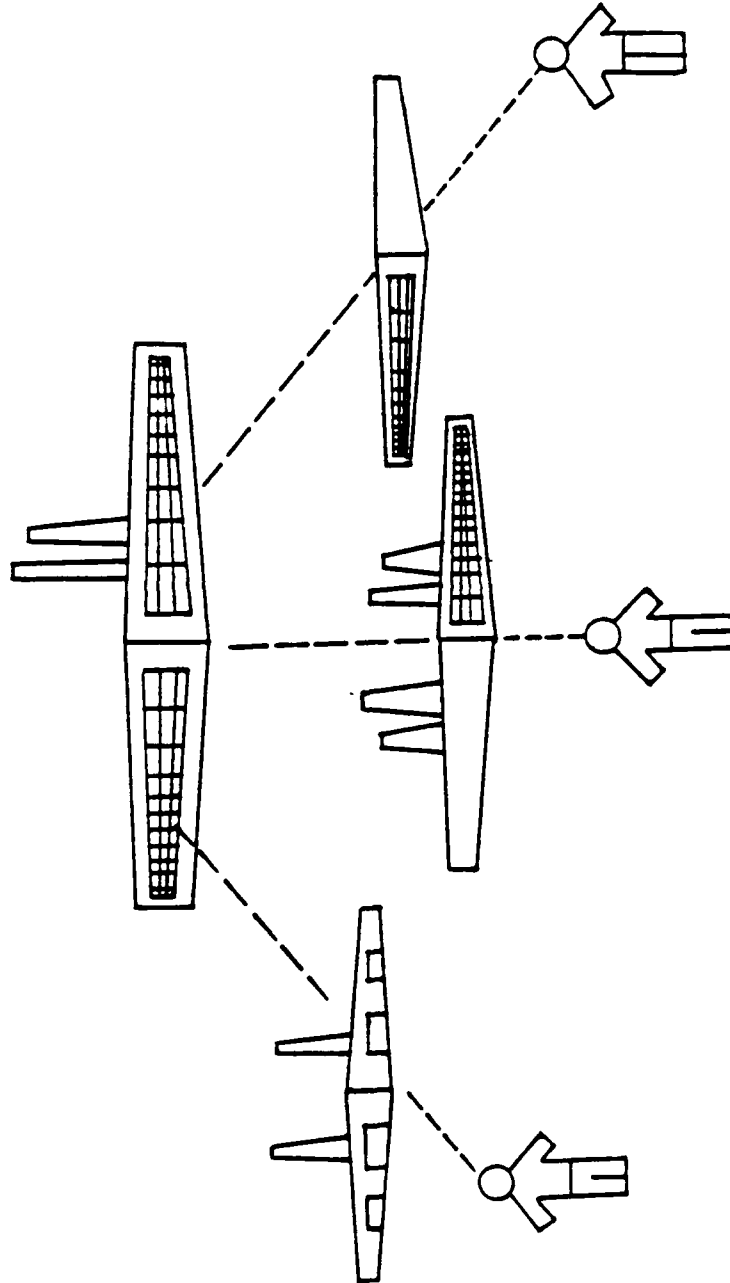
## KEY



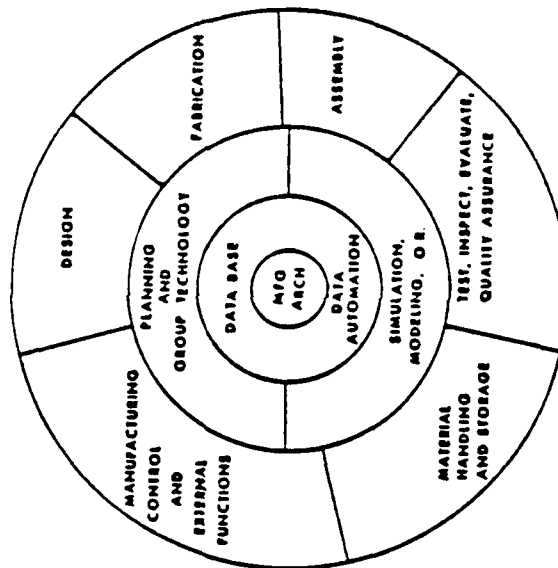
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# HOW DOES IDEF RELATE TO ARCHITECTURE ?

# ARCHITECTURE STANDARD FOR COMMUNICATION

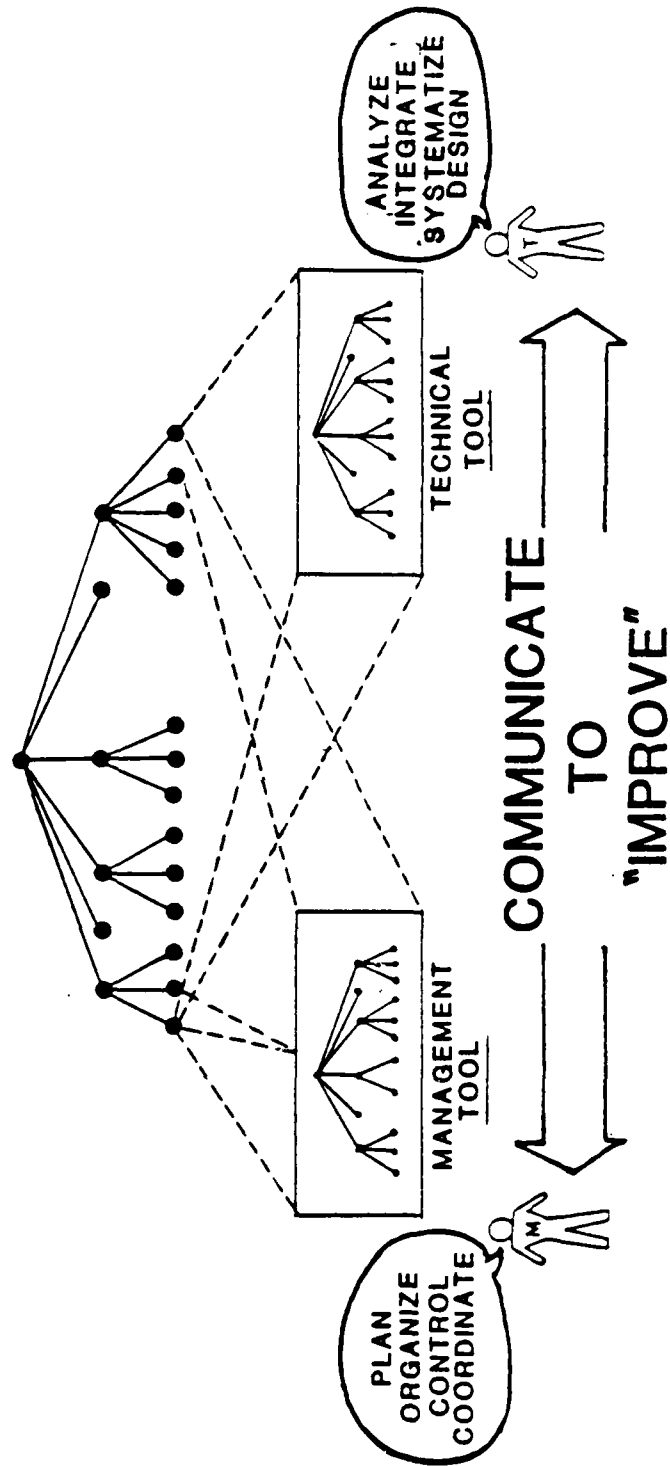


# ICAM INTEGRATED COMPUTER-AIDED MANUFACTURING



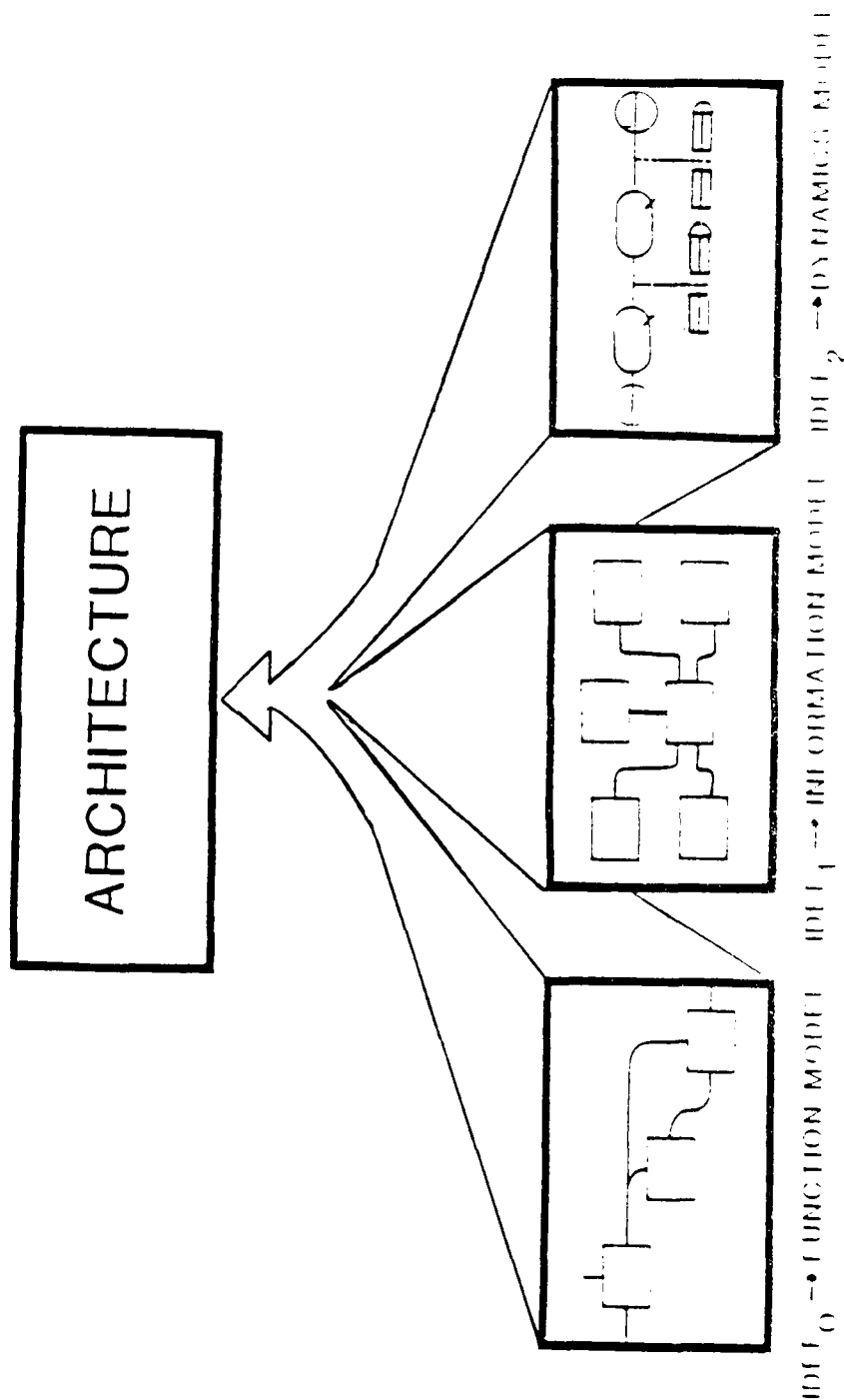
# ARCHITECTURE

## MANUFACTURING



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# ARCHITECTURE



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# **ICAM OBJECTIVE**

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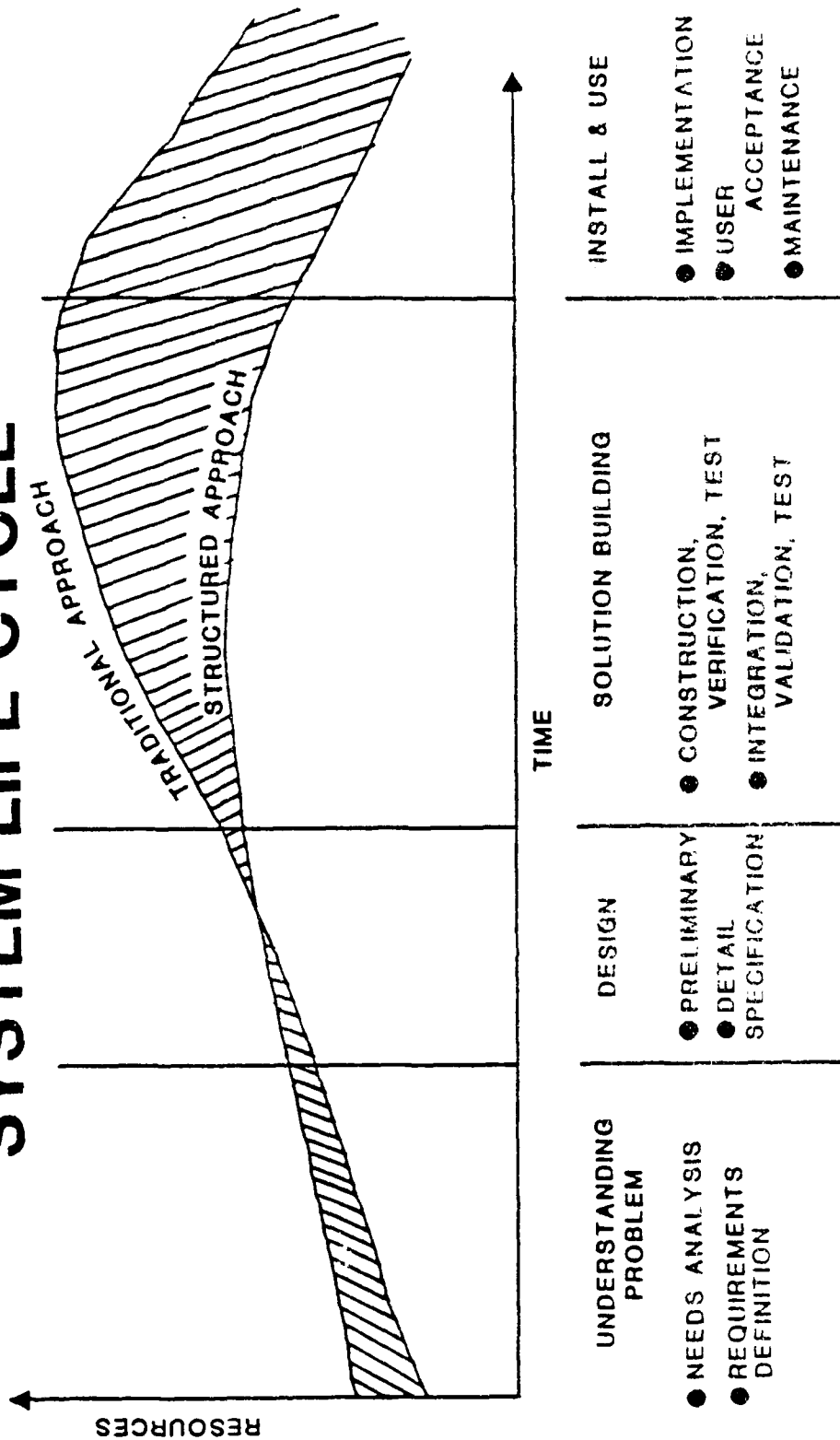
**IDEF AND ARCHITECTURE ARE TOOLS .....**

**NOT OBJECTIVES**

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8 September 1987

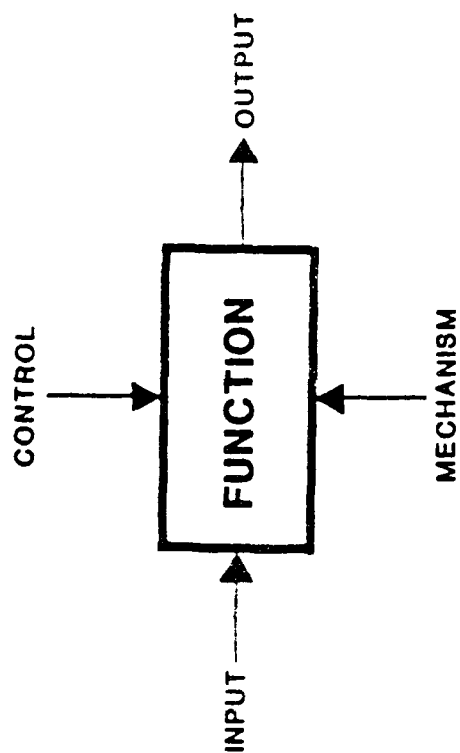


# IDEF → ARCHITECTURE SYSTEM LIFE CYCLE



IDEF IS THE METHOD  
ARCHITECTURE IS THE MEANS  
PRODUCTIVITY IS THE OBJECTIVE

IDEF<sub>0</sub>



AUTHORING  
CONCEPTS AND PROCEDURES

## **AUTHORING CONCEPTS AND PROCEDURES**

## **LEARNING OBJECTIVES**

1. UNDERSTAND IDEF<sub>0</sub> (FUNCTION MODEL) GRAPHIC SYNTAX, I.E. SYMBOLS
2. UNDERSTAND THE BASIC CONCEPTS OF IDEF<sub>0</sub>
3. UNDERSTAND THE DIFFERENT USES THAT DATA CAN PLAY IN FUNCTION  
MODELING WITH IDEF<sub>0</sub> :
  - a. INPUTS
  - b. CONTROLS
  - c. OUTPUTS
  - d. MECHANISMS
4. UNDERSTAND IDEF<sub>0</sub> (FUNCTION MODEL) DIAGRAM DECOMPOSITION
5. UNDERSTAND AUTHORING AND REFINING IDEF<sub>0</sub>  
(FUNCTION MODEL) DIAGRAMS.

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9 September 1963

# **AUTHORING CONCEPTS**      **DEFINITIONS AND EXAMPLES**

## DEFINITIONS

### SYNTAX I.E. SYMBOLS:

- STRUCTURAL COMPONENTS OR "SYMBOLS"
- RULES THAT DEFINE RELATIONS AMONG THE COMPONENTS

### SEMANTICS I.E. CONCEPTS:

- MEANING OF SYNTACTIC COMPONENTS
- INTERPRETATION OF SYNTACTIC RULES

## EXAMPLES IN IDEF<sub>0</sub>

### SYMBOLS:

- BOXES
- ARROWS

### RULES:

- "USE ONLY 3-6 BOXES IN A DIAGRAM LAYOUT"

### CONCEPTS:

- FUNCTIONS ... BOXES
- INTERFACE-CONSTRAINTS ... ARROWS
- "USE ONLY 3-6 BOXES IN A DIAGRAM LAYOUT"
- LESS THAN 3 BOXES -NOT ENOUGH DETAIL
- MORE THAN 6 BOXES -CLUTTERS AND DETRACTS FROM READABILITY

## AUTHORING CONCEPTS | FUNCTION

### "FUNCTION"

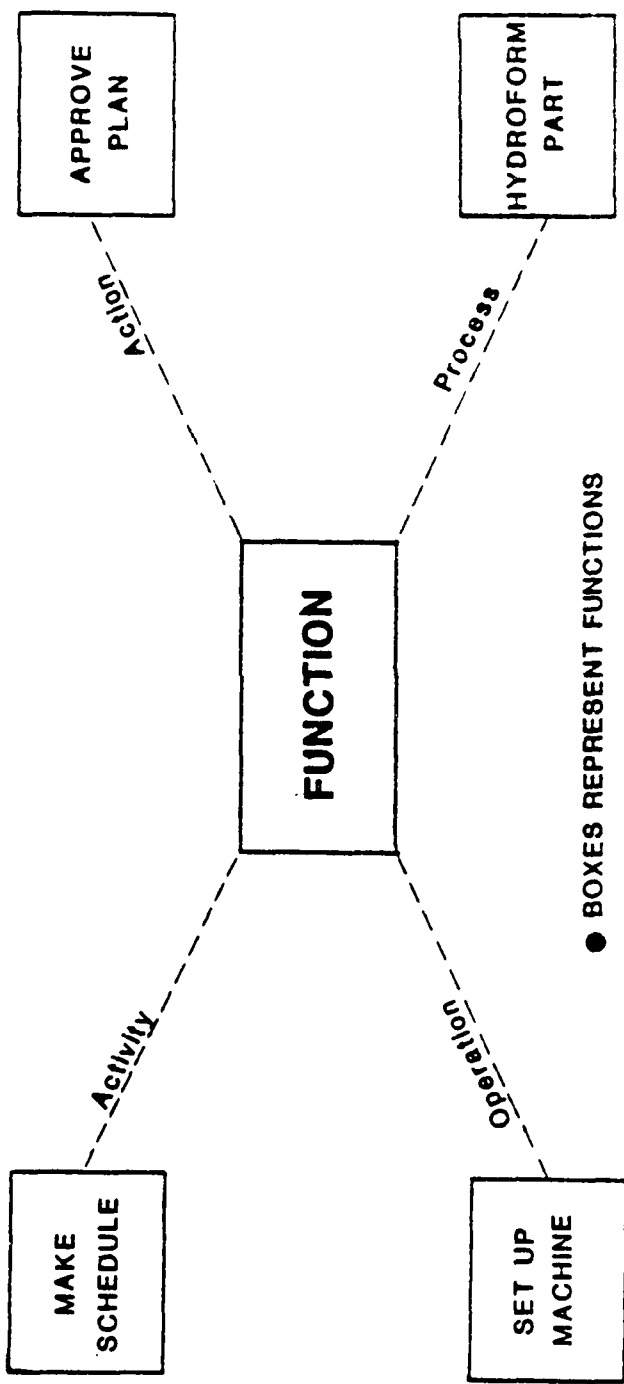
#### DEFINITION:

- AN ACTIVITY, ACTION, PROCESS, OPERATION.
- A DESCRIPTION OF "WHAT HAPPENS" IN A PARTICULAR ENVIRONMENT - WHAT IT MEANS TO DO SOMETHING.
- FUNCTIONS THAT ARE DONE BY PEOPLE, MACHINES, COMPUTERS, ETC.

#### CHARACTERISTICS:

- ACTIVE VERB OR VERB PHRASE
- OCCURS OVER TIME
- RECOGNIZABLE RESULTS

**AUTHORING CONCEPTS** | **SYNTACTIC COMPONENTS: BOXES**



- BOXES REPRESENT FUNCTIONS
- FUNCTION SYNTAX IS A BOX

## **AUTHORING CONCEPTS | DATA**

### **DEFINITION:**

- INFORMATION / PHYSICAL OBJECTS

### **CHARACTERISTICS:**

- NOUN OR NOUN PHRASE

### **RELATIONSHIP TO FUNCTION:**

- UNDERGO CHANGES BY FUNCTION
- DETERMINE OR AFFECT FUNCTION
- RESULT FROM FUNCTION
- CARRY OUT FUNCTION

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8 September 1983



**AUTHORING CONCEPTS** | **DATA: PRIOR TO/RESULTING FROM ACTIVATION OF FUNCTION**

DATA PRIOR TO ACTIVATION OF FUNCTION	FUNCTION	DATA RESULTING FROM ACTIVATION OF FUNCTION
<ul style="list-style-type: none"> <li>● PRODUCT MANUFACTURING REQUIREMENTS</li> </ul>	<ul style="list-style-type: none"> <li>● PLAN FOR MANUFACTURE</li> </ul>	<ul style="list-style-type: none"> <li>● MANUFACTURING PLAN</li> </ul>
<ul style="list-style-type: none"> <li>● PRODUCT SPECIFICATIONS</li> </ul>	<ul style="list-style-type: none"> <li>● PRODUCE PRODUCT</li> </ul>	<ul style="list-style-type: none"> <li>● PRODUCT</li> </ul>
<ul style="list-style-type: none"> <li>● RAW MATERIALS</li> <li>● BLUEPRINTS</li> <li>● WORK ORDERS</li> <li>● INSTRUCTIONS</li> </ul>	<ul style="list-style-type: none"> <li>● MAKE PART</li> </ul>	<ul style="list-style-type: none"> <li>● FABRICATED PARTS</li> <li>● SCRAP</li> </ul>

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8 SEPTEMBER 1959

**USES OF DATA: INPUTS, CONTROLS,  
OUTPUTS AND MECHANISMS**

**AUTHORING CONCEPTS**

**INPUT: DATA WHICH UNDERGOES A CHANGE  
AND IS TRANSFORMED**

**CONTROL: DATA WHICH INFLUENCES OR DETERMINES  
THE FUNCTION OUTPUT (S)**

**OUTPUT: DATA WHICH RESULTS FROM A FUNCTION:  
DATA CREATED BY A FUNCTION**

**MECHANISM: DATA WHICH CARRIES OUT A FUNCTION**

# **AUTHORING CONCEPTS DATA ROLES IN IDEF<sub>0</sub>**

INPUT(S)	CONTROL(S)	FUNCTION	OUTPUT(S)
<ul style="list-style-type: none"> <li>● PROCURABLE ITEMS</li> </ul>	<ul style="list-style-type: none"> <li>● PRODUCT DESIGN</li> </ul>	<ul style="list-style-type: none"> <li>● MANUFACTURE PRODUCT</li> </ul>	<ul style="list-style-type: none"> <li>● PRODUCT</li> </ul>
<ul style="list-style-type: none"> <li>● RAW MATERIALS</li> </ul>	<ul style="list-style-type: none"> <li>● BLUEPRINT</li> <li>● WORKORDER</li> <li>● INSTRUCTIONS</li> </ul>	<ul style="list-style-type: none"> <li>● MAKE PART</li> </ul>	<ul style="list-style-type: none"> <li>● FABRICATED PART</li> <li>● SCRAP</li> </ul>
<ul style="list-style-type: none"> <li>● EXPERIENCE &amp; CAPABILITY INFORMATION</li> </ul>	<ul style="list-style-type: none"> <li>● RESOURCE REQUIREMENTS</li> </ul>	<ul style="list-style-type: none"> <li>● ESTIMATE RESOURCE NEEDS</li> </ul>	<ul style="list-style-type: none"> <li>● RESOURCE PLANS</li> </ul>
"INPUT" DATA		"OUTPUT" DATA	

7-1111-1-1  
SEPTEMBER 1990

## AUTHORING CONCEPTS      MECHANISM

### DEFINITION:

- THE MEANS BY WHICH A FUNCTION IS DONE
- THE ORIGIN, SOURCE, OR AGENT THAT ENABLES A FUNCTION TO BE ACCOMPLISHED

### CHARACTERISTICS:

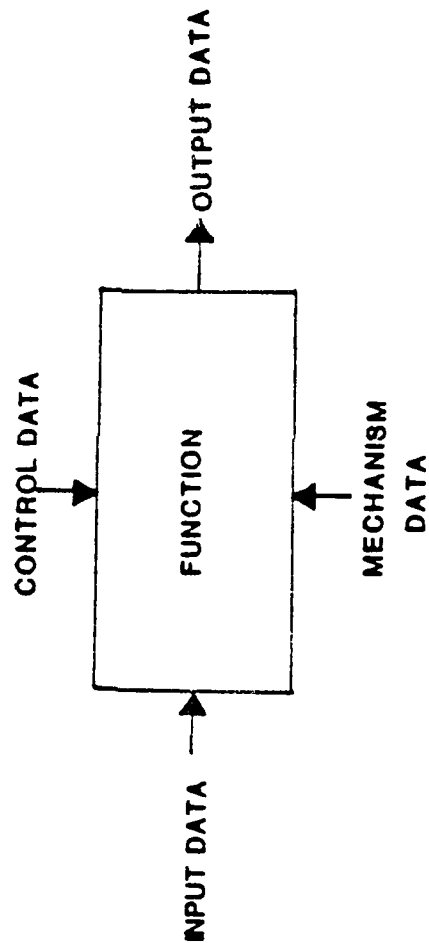
- NOUN OR NOUN PHRASE
- TYPICALLY A PERSON, MACHINE, OR COMPUTER

FTR11041000001  
8 September 1983

## **AUTHORING CONCEPTS**

## **SYNTACTIC COMPONENTS: ARROWS**

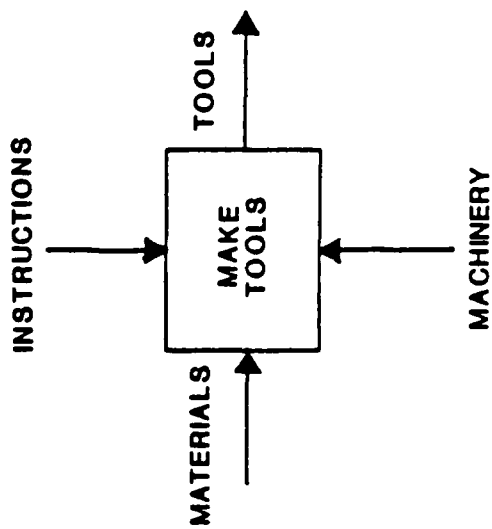
- ARROWS REPRESENT DATA
- ARROWS ALWAYS CONNECT TO A BOX



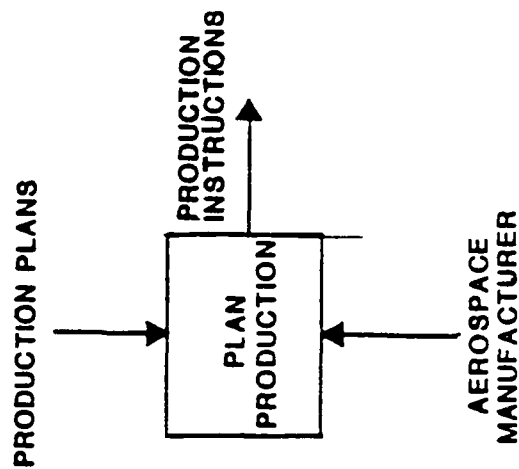
- DATA SYNTAX IS AN ARROW

**AUTHORING CONCEPTS** | **FUNCTIONS AND DATA**

**"TRANSFORMATION TYPE FUNCTION"**

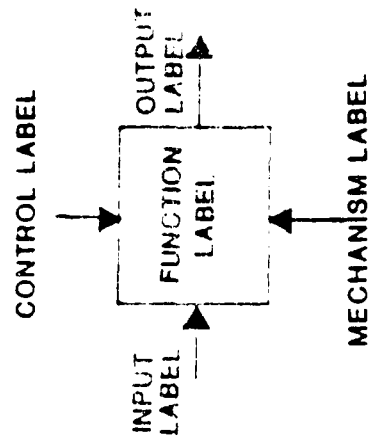


**"NON TRANSFORMATION TYPE FUNCTION"**



## AUTHORING CONCEPTS | LABELS

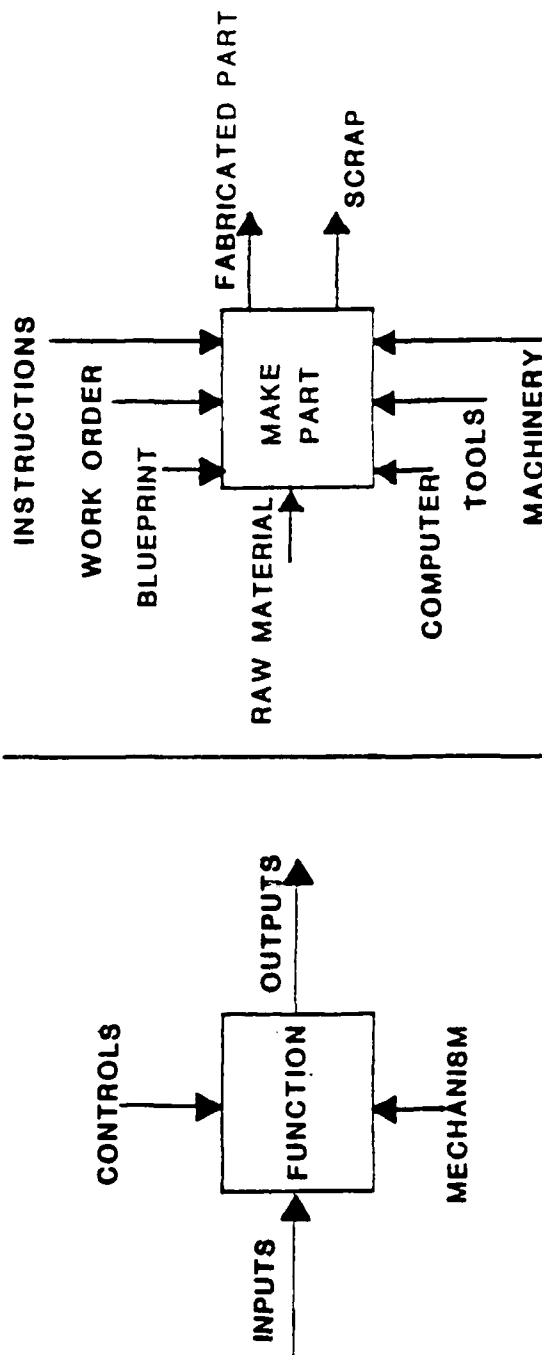
- LABELS ARE WORDS THAT NAME FUNCTIONS AND DATA
- FUNCTION LABELS ARE VERBS OR VERB PHRASES AND ARE PUT IN THE CENTER OF THE FUNCTION BOX
- DATA LABELS ARE NOUNS OR NOUN PHRASES
- DATA LABELS ARE ASSOCIATED WITH INPUT, CONTROL, OUTPUT, AND MECHANISM ARROWS
- DATA LABELS ARE PLACED AS NEAR TO THEIR RESPECTIVE ARROWS AS POSSIBLE



THE CHOICE OF WORDS IN NAMING LABELS IS CRITICAL

# AUTHORING CONCEPTS FUNCTIONS, DATA AND LABELS

EXAMPLE:



FTR1104100000  
8 September 1968

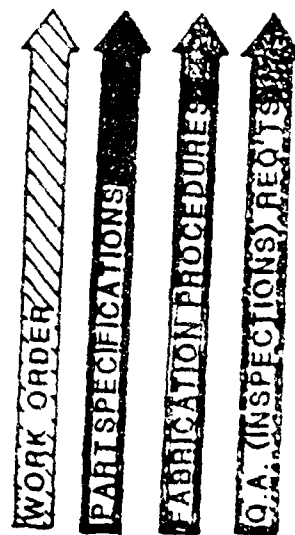


# AUTHORING CONCEPTS DATA ARROWS: "PIPELINES"

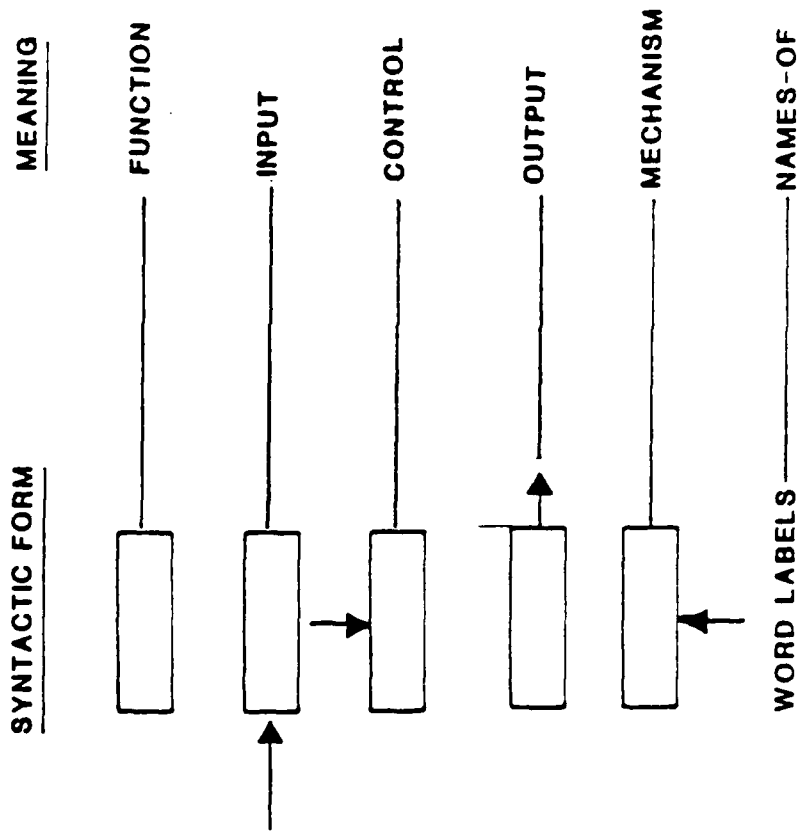
INPUT, OUTPUT, AND CONTROL ARROWS REPRESENT  
"CLASSES" OR "CATEGORIES" OF DATA.

ANALOGY < ● PIPE LINES  
● COAXIAL CABLES

## WORK PACKAGE



# AUTHORING CONCEPTS SYNTAX COMPONENTS: REVIEW



## AUTHORING CONCEPTS | EXERCISE

### INSTRUCTIONS:

BASED ON THE NARRATIVE, IDENTIFY TERMS WHICH DESCRIBE FUNCTIONS, INPUTS, CONTROLS, OUTPUTS, AND MECHANISMS. LIST THE TERMS IN THE APPROPRIATE SPACES BELOW.

### NARRATIVE:

BUILD A MODEL AIRPLANE, GIVEN A KIT WHICH CONTAINS MATERIALS AND INSTRUCTIONS. THE KIT INCLUDES THE FOLLOWING ITEMS:

- PRINTED PAMPHLET WITH STEP-BY-STEP INSTRUCTIONS
- GLUE
- RUBBER BAND (FOR PROPULSION)
- BALSA WOOD
- PAINT
- DECAL
- APPLICATORS FOR PAINT AND GLUE

FUNCTIONS	INPUTS	CONTROLS	OUTPUTS	MECHANISMS

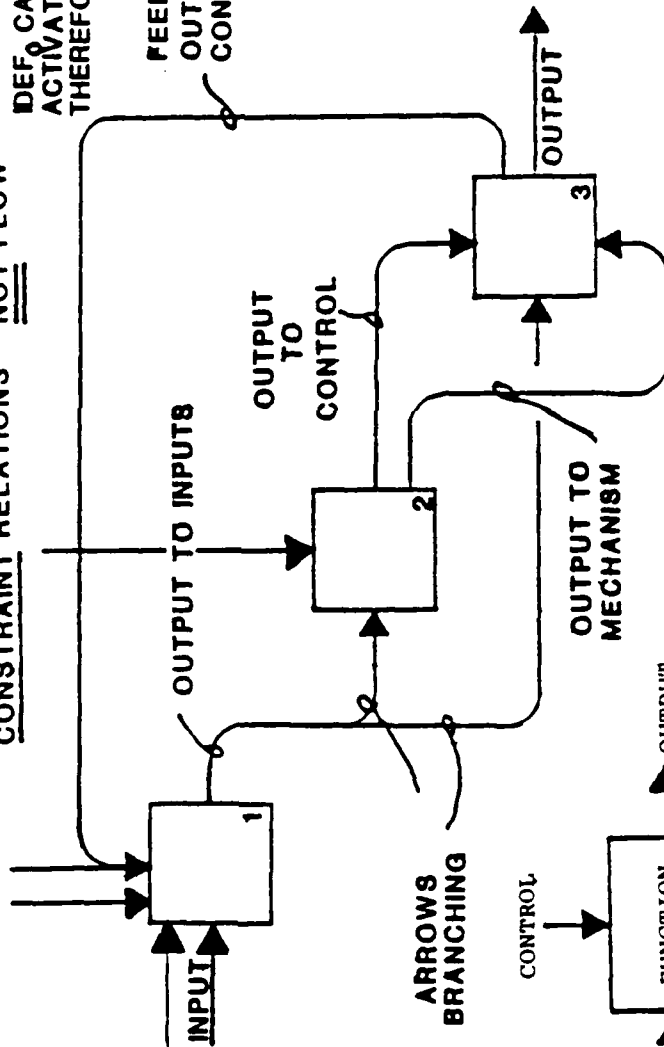
# AUTHORING CONCEPTS

## BOX AND ARROW RELATIONS: CONSTRAINTS

BOX AND ARROW CONNECTIONS SHOW

CONSTRAINT RELATIONS - NOT FLOW

DEF<sub>0</sub> CAPTURES ALL POSSIBLE  
ACTIVATIONS OF FUNCTION,  
THEREFORE CAPTURES ALL TIME.



ARROWS  
BRANCHING

CONTROL

KEY:

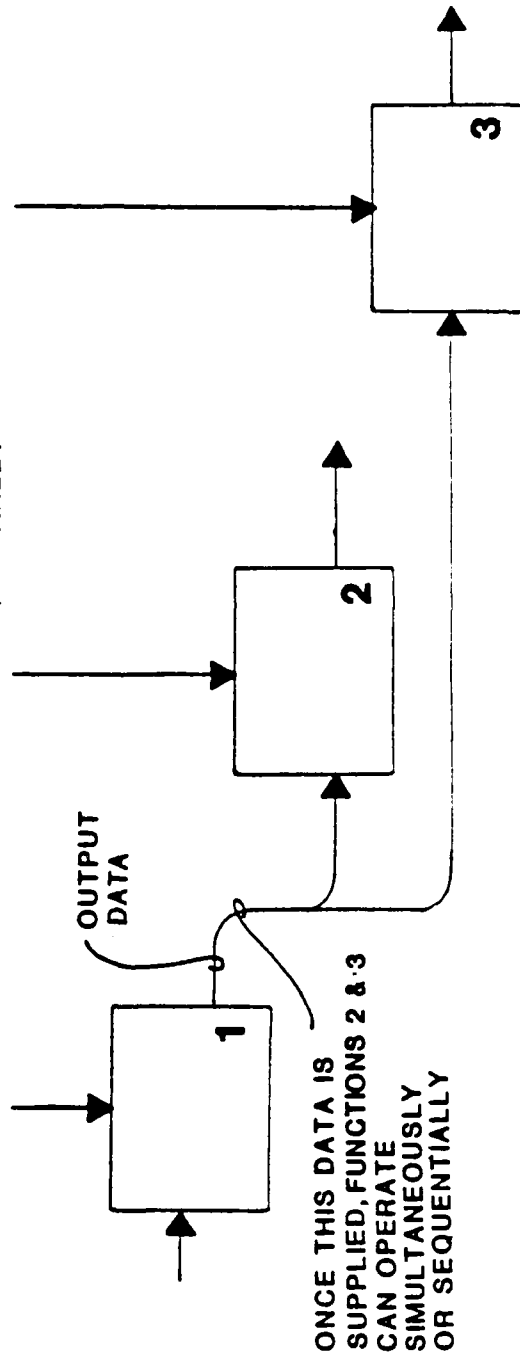
INPUT → OUTPUT

FUNCTION

MECHANISM

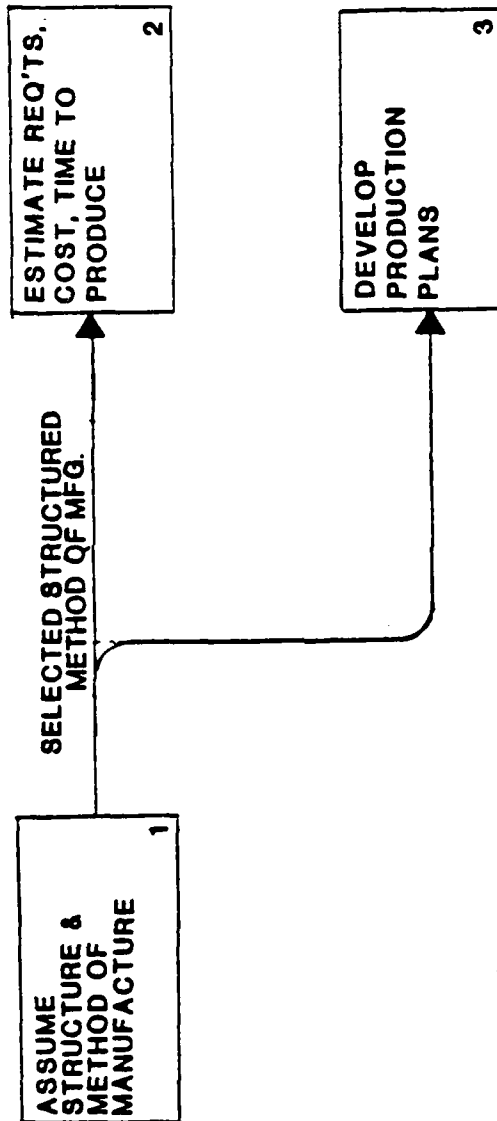
## AUTHORING CONCEPTS      ARROWS: "BRANCHING"

OUTPUT CAN BRANCH AND BE USED BY TWO FUNCTIONS  
SIMULTANEOUSLY OR SEQUENTIALLY



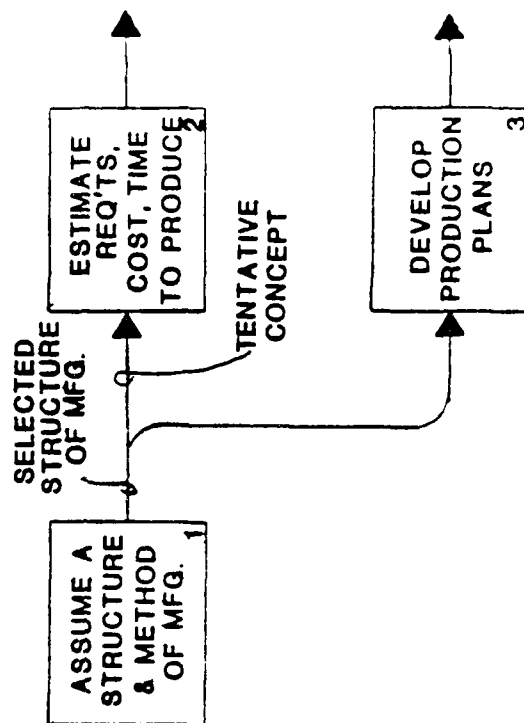
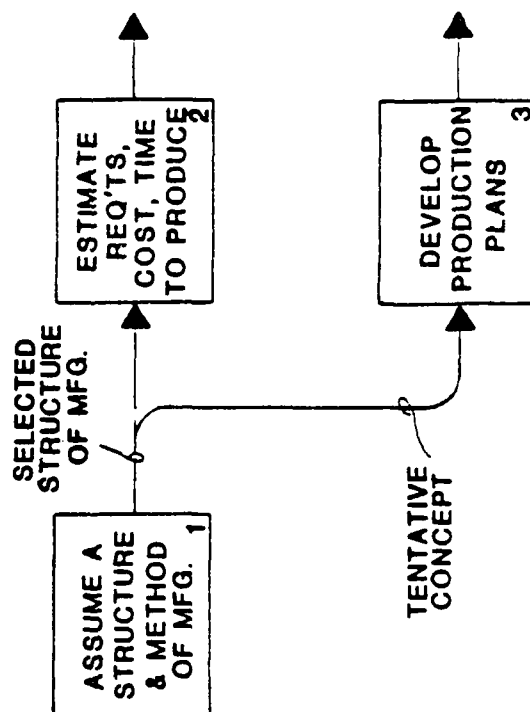
● WITHOUT LABELS WE CANNOT TELL HOW THE  
BRANCH OCCURS

**AUTHORING CONCEPTS      ARROWS: "BRANCHING"**



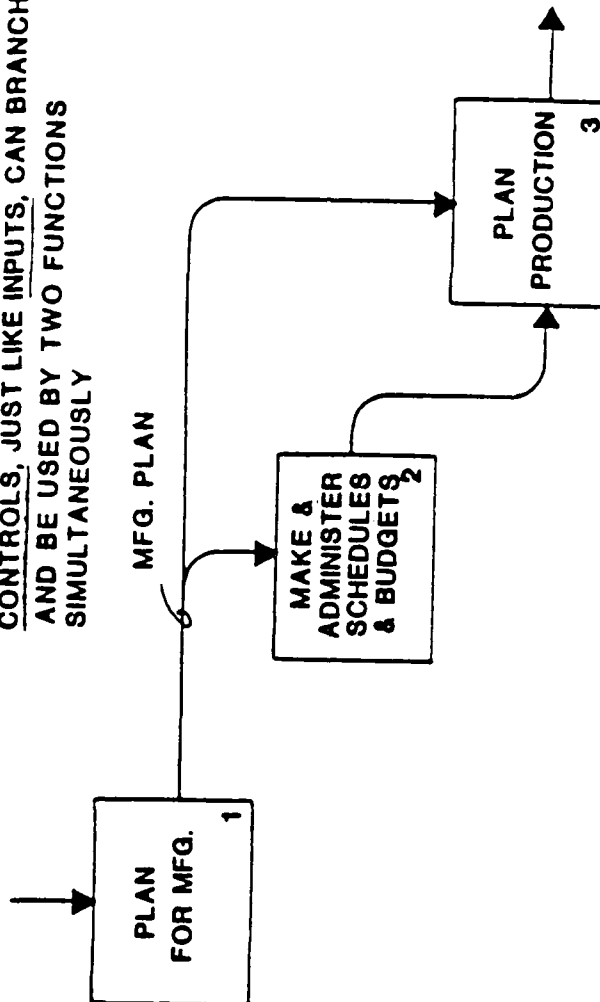
OUTPUT FROM ONE FUNCTION  
IN ABOVE EXAMPLE SEPARATES INTO  
TWO CATEGORIES AND BECOMES  
INPUT TO TWO OTHER FUNCTIONS

# AUTHORING CONCEPTS      ARROWS - "BRANCHING"



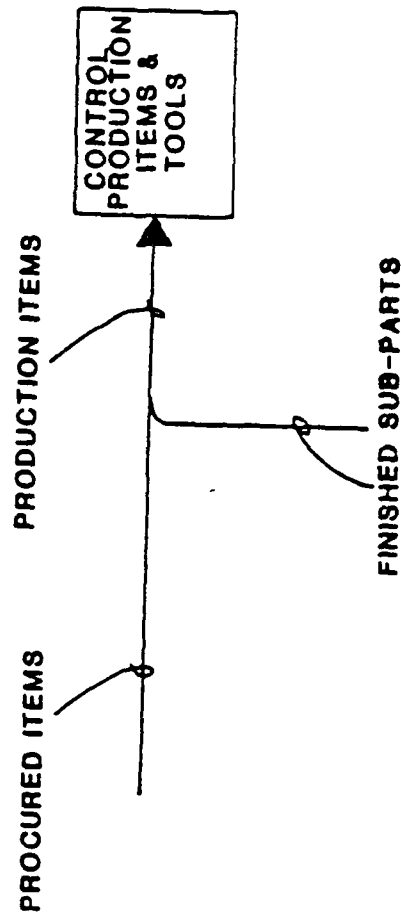
# AUTHORING CONCEPTS      ARROWS: "BRANCHING"

CONTROLS, JUST LIKE INPUTS, CAN BRANCH  
AND BE USED BY TWO FUNCTIONS  
SIMULTANEOUSLY



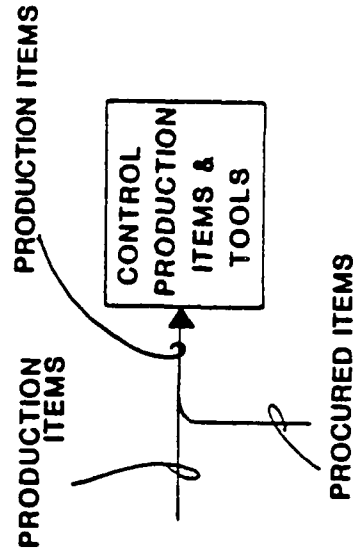
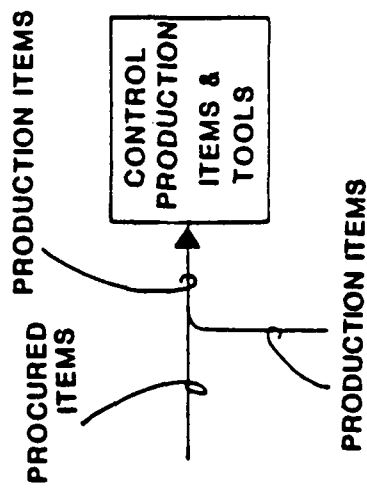


**EXAMPLE:**

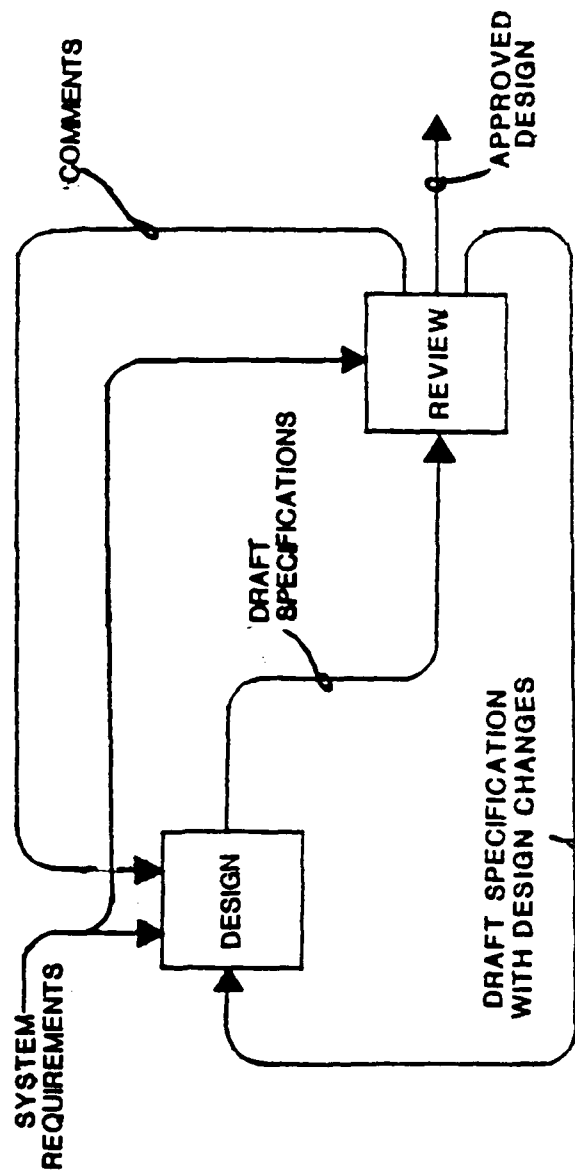


**AUTHORING CONCEPTS      ARROWS - "JOINING"**

OTHER VALID FORMS



## AUTHORING CONCEPTS ARROWS--"FEEDBACK"

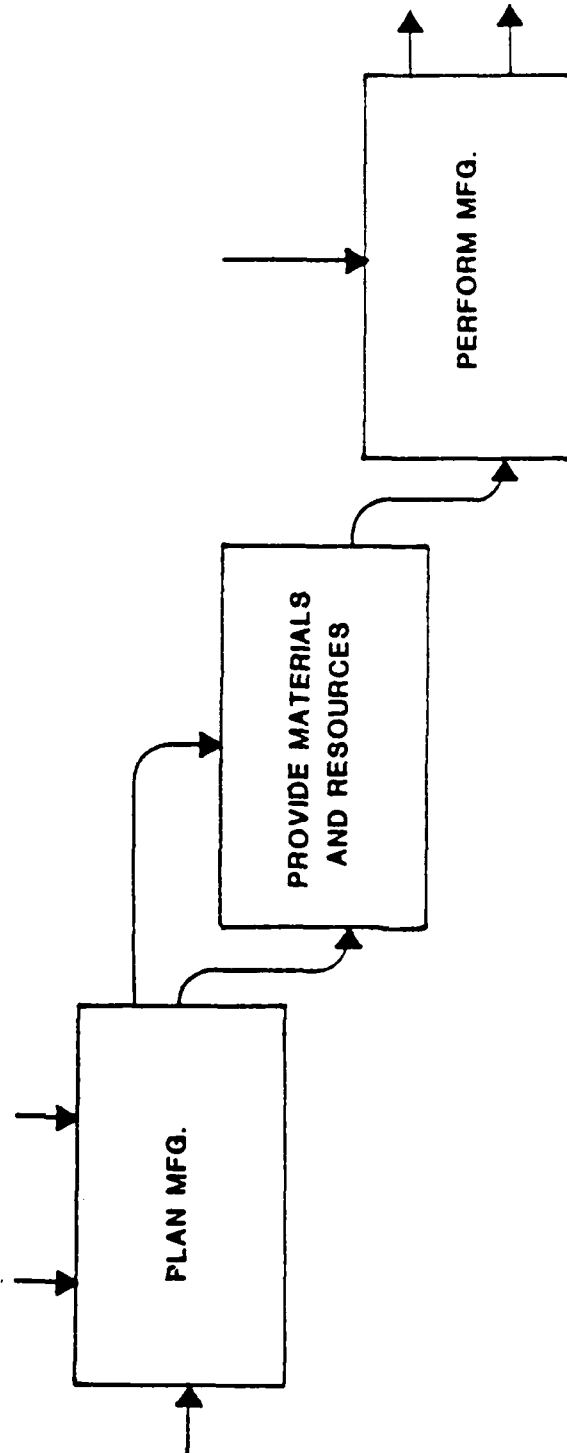


## **AUTHORING CONCEPTS      DECOMPOSITION**

- FUNCTIONS ARE COMPRISED OF SUBFUNCTIONS
- DECOMPOSITION IS AN "EXPLOSION" OF DETAIL (LEVEL BY LEVEL)
- DATA CONSISTENCY IS REQUIRED (LEVEL BY LEVEL)
- ESTABLISHES MODEL HIERARCHY AND NODE NUMBERING

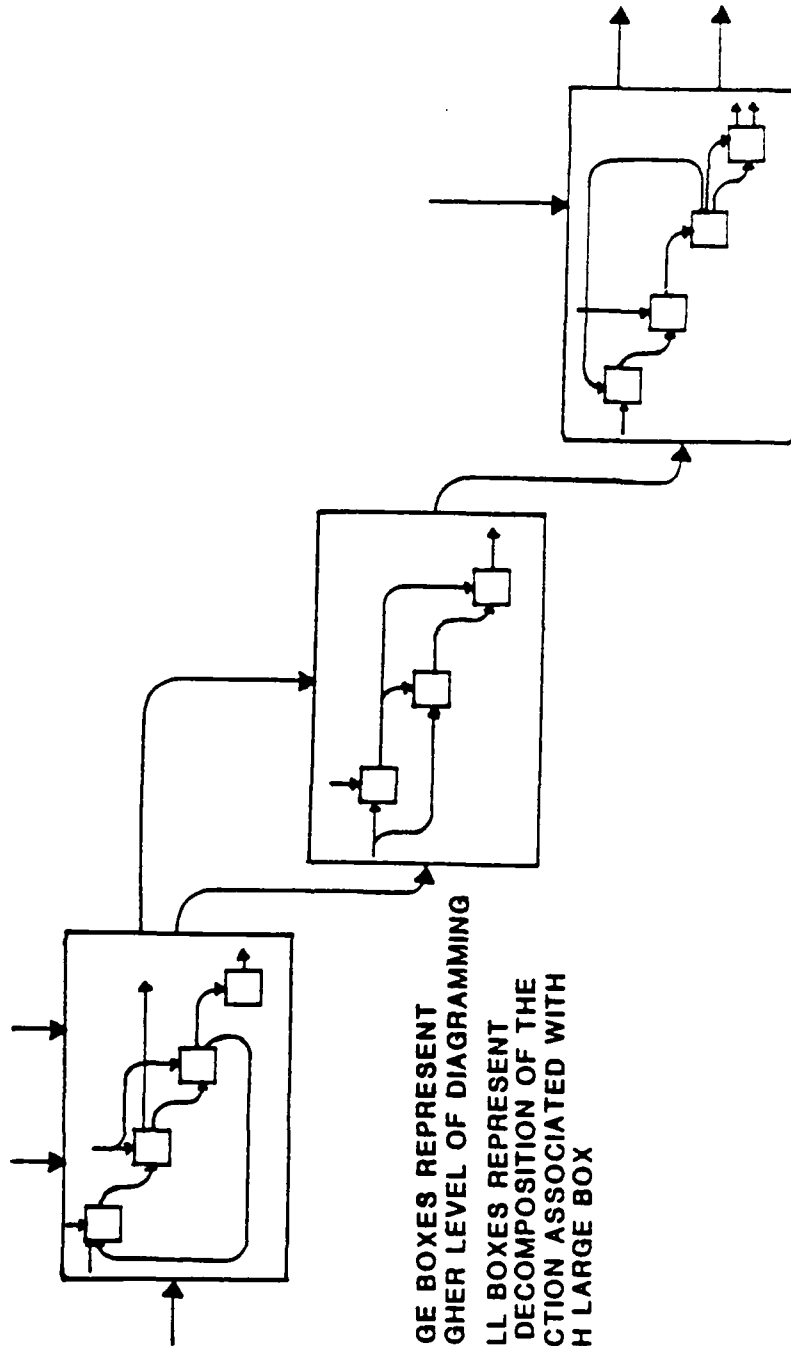
FTR1104100000  
6 September 1963

**AUTHORING CONCEPTS      DECOMPOSITION**



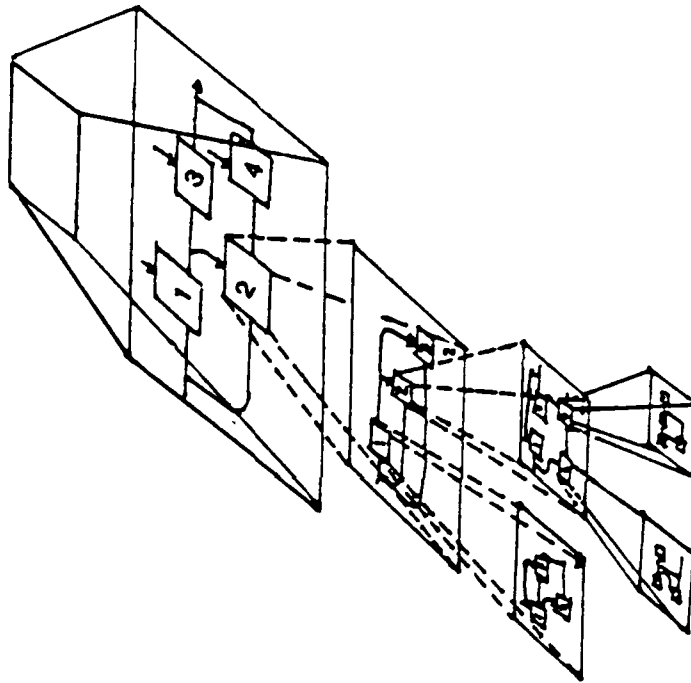
FTAI10410000  
8 September 1968

## AUTHORING CONCEPTS | DECOMPOSITION



LARGE BOXES REPRESENT  
A HIGHER LEVEL OF DIAGRAMMING  
SMALL BOXES REPRESENT  
THE DECOMPOSITION OF THE  
FUNCTION ASSOCIATED WITH  
EACH LARGE BOX

# AUTHORING CONCEPTS DECOMPOSITION



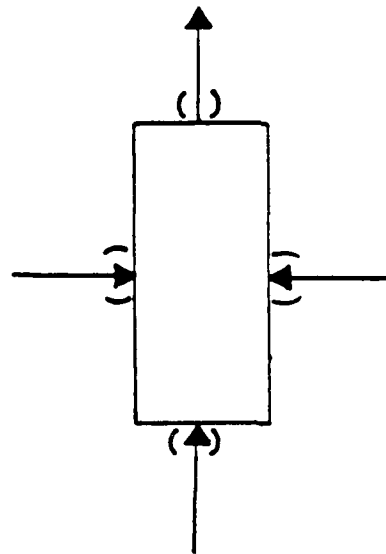
MORE GENERAL



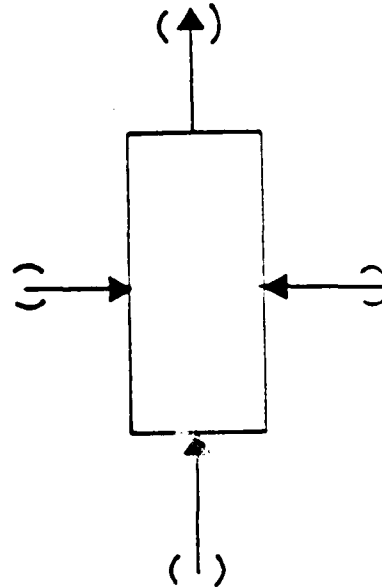
MORE DETAILED

# AUTHORING CONCEPTS DECOMPOSITION

## TUNNELLED ARROWS



ARROW WILL NOT APPEAR  
ON DECOMPOSED DIAGRAM

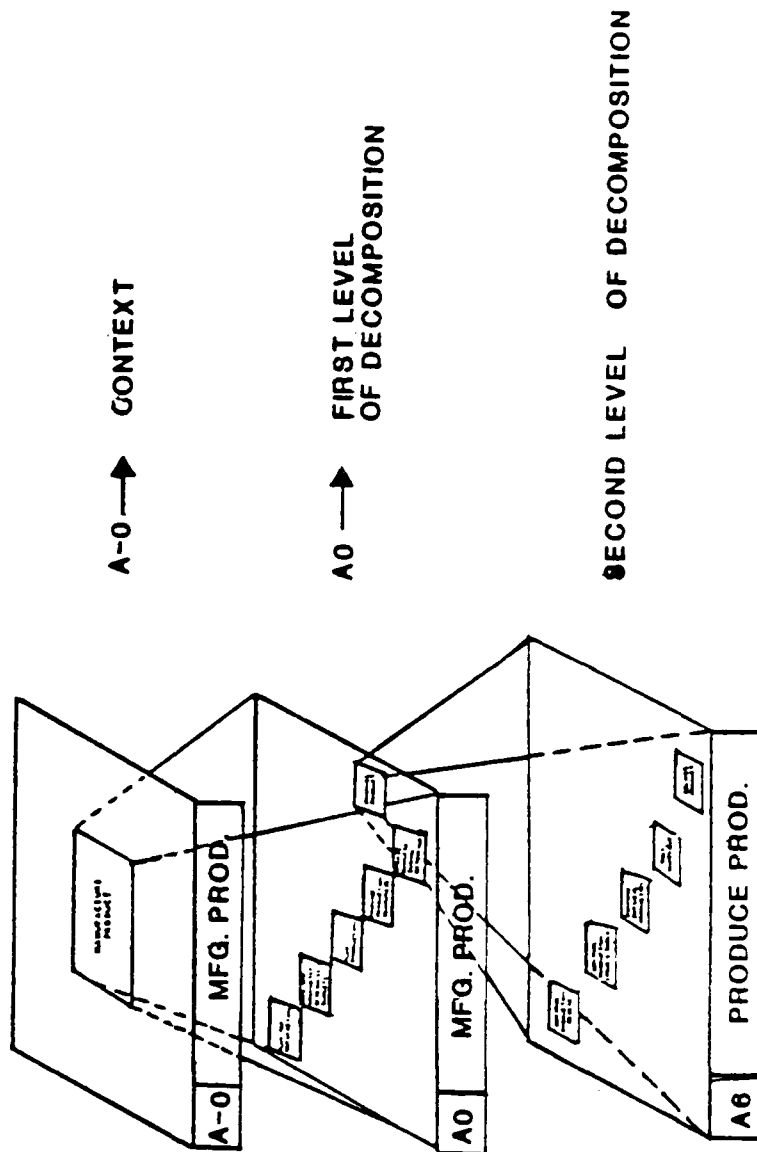


ARROW WILL NOT APPEAR  
ON PARENT DIAGRAM



# AUTHORING CONCEPTS DECOMPOSITION

A MODEL ORGANIZES DIAGRAMS INTO A  
STRUCTURED DECOMPOSITION



FTR1104100000  
8 September 1983

AUTHORING CONCEPTS	NODE NUMBER
--------------------	-------------

INDICATES

- DIAGRAM, TEXT, FEO, GLOSSARY
- LEVEL OF HIERARCHY (DECOMPOSITION)
- PARENT DIAGRAM
- LOCATION IN PARENT DIAGRAM

# **AUTHORING CONCEPTS**

## **NODE NUMBER**

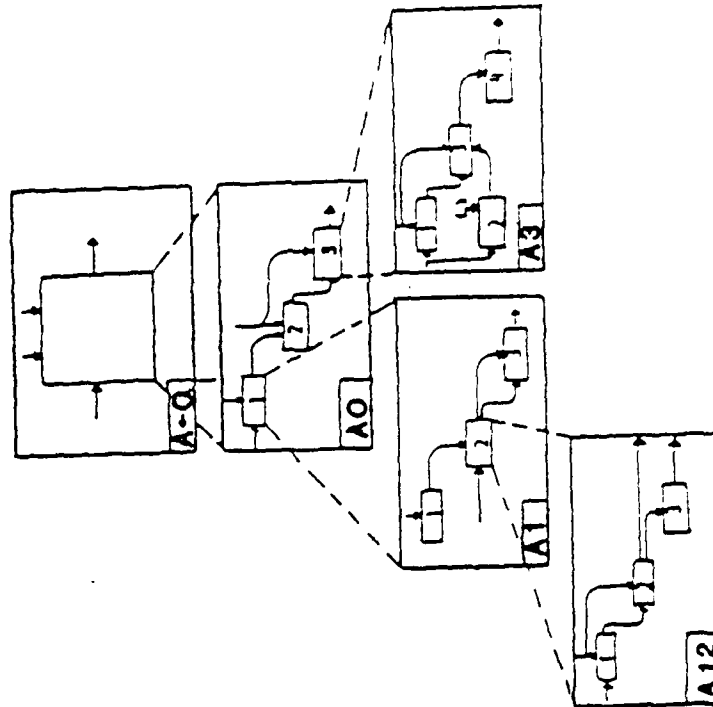
NODE NUMBER CORRESPONDS TO  
POSITION IN HIERARCHY

A-0 = TOP LEVEL (CONTEXT)

A0 = FIRST LEVEL

A1 } PARTIAL  
A3 } DECOMPOSITION  
OF A0

A12 = PARTIAL  
DECOMPOSITION  
OF A1



AUTHORING PROCEDURES	PROCESS
-------------------------	---------

- DEFINE CONTEXT, VIEWPOINT AND PURPOSE
- BOUND THE CONTEXT
- COLLECT DATA
- LIST DATA AND FUNCTIONS
- CLUSTER DATA AND FUNCTIONS
- SKETCH DATA AND ARROWS (LAYOUT)
- REFINE LAYOUT
- CONSTRUCT FEO'S, TEXT, AND GLOSSARY  
WHERE NEEDED

# **AUTHORING PROCEDURES**

---

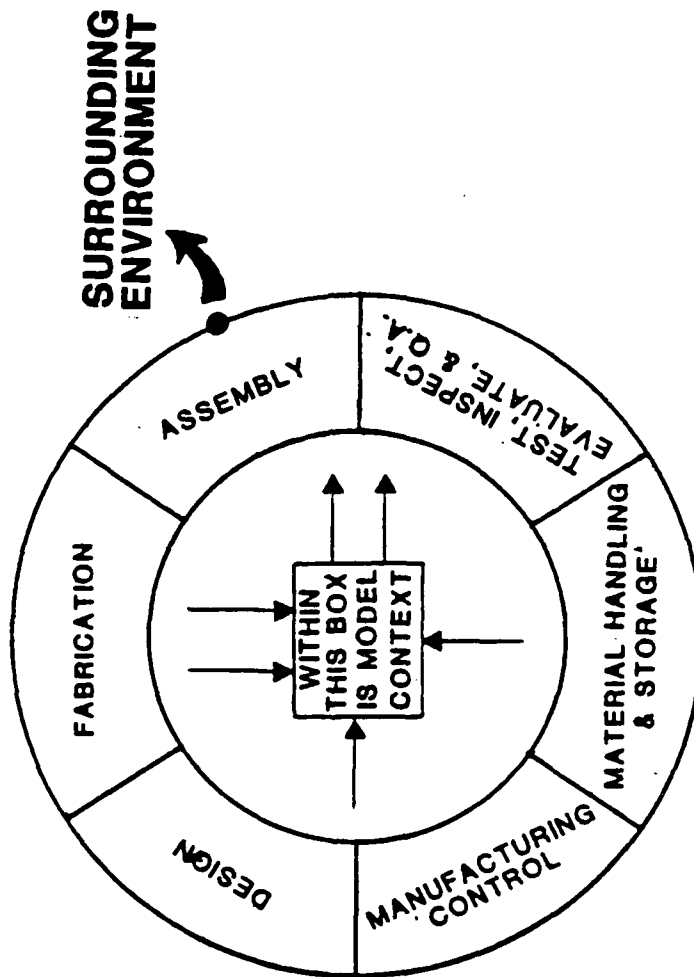
## **ORIENTATION OF MODELS**

### **DEFINITIONS:**

- CONTEXT (SUBJECT)  
THE SCOPE OR BOUNDARIES OF THE  
SUBJECT MATTER
- VIEWPOINT (BIAS)  
THE PERSPECTIVE FROM WHICH A  
SUBJECT IS ANALYZED
- PURPOSE (OBJECTIVE)  
THE REASON(S) A MODEL IS CREATED:  
THE WAYS THAT IT COULD BE USED

FTR110410000  
8 September 1983

**AUTHORING PROCEDURES** | **BOUND THE CONTEXT**



THE INPUTS, CONTROLS, OUTPUTS, AND MECHANISMS  
DEFINE THE INTERFACE BETWEEN THE MODEL CONTEXT  
AND THE SURROUNDING ENVIRONMENT.

<b>AUTHORING PROCEDURES</b>	<b>DATA COLLECTION</b>
---------------------------------	------------------------

**HOW:**

- **READ RELEVANT REFERENCE MATERIAL**
- **INTERVIEW EXPERTS**
- **OBSERVE THE SYSTEM IN PROGRESS**

<b>AUTHORING PROCEDURES</b>	<b>DATA COLLECTION</b>
---------------------------------	------------------------

WHAT:

- **DEFINITIONS**
- **FUNCTIONS**
- **DATA**



# AUTHORING PROCEDURES

## LIST DATA AND FUNCTIONS

USED AT:	AUTHOR: C. Menken PROJECT: IM28	DATE: 9/19/67 REV:	READER	DATE	CONTENT:
NOTES: 1 2 3 4 5 6 7 8 9 10		WORKING DRAFT RECOMMENDED PUBLICATION			
<p><u>Data</u></p> <p>Shop Orders Shop Order form Raw Material Inventory Sheet Quantity Material Losses Material Shortage Reports</p> <p><u>Shop load</u> Budget Data for Release Shop Capacity Ordering Errors Fulfilled Orders Notice of Revisions</p> <p><u>Production Requirements</u> Company Specifications</p>					
<p><u>Functions</u></p> <p>Review Shop orders Review Material Inventories Calculate Shop Capacity Estimate Load Review Shortages</p> <p>Decision Budget Approval Adjustments Calculate Adjustments</p> <p>Review Release Dates Clarify Problems Document Problems Develop Release Schedule</p>					
NUMBER	AD 51	TITLE	Adjust Release Schedule		NUMBER
					One

# AUTHORING PROCEDURES

## CLUSTER DATA AND FUNCTIONS

USED AT:	AUTHOR: C. Meulen	DATE: 9/14/84	READER:	DATE:	CONTEXT:
PROJECT: INC		REV:	DRAFT		
NOTES: 1 2 3 4 5 6 7 8 9 10			RECOMMENDED		
			PUBLICATION		

**Data**

Stop Orders  
Stop Order Form  
Stop Material Inventory  
Stop Capacity  
Material Losses  
Material Shortage Reports

Stop load  
Budget for Release  
Ordering Errors  
Revised Orders  
Office of Revisions

Production Requirements  
Company Specifications

**FUNCTIONAL FORECAST**

Review Shop orders  
Review Material Inventories  
Calculate Stop Capacity  
Estimate Load  
Address Shortage

Decide Priorities  
against Budget  
Formalizing Adjustments  
Approved Adjustments  
Evaluate Adjustments

Review Release Dates  
Clarify Problems  
Document Problems  
Develop Release  
Schedule

SELECT ORDERS  
FOR RELEASE

MODE: AO FI	TITLE: Adjust Release Schedule	NUMBER: Cm
-------------	--------------------------------	------------

# AUTHORING PROCEDURES A-O DIAGRAM

USED AT:	AUTHOR: PROJECT:	DATE: REV:	WORKING DRAFT RECOMMENDED PUBLICATION	READER	DATE	CONTENT:
NOTE: 1 2 3 4 5 6 7 8 9 10						

**ADJUST RELEASE SCHEDULE**

PRODUCTION REQUIREMENT →

BUDGETED CAPACITY →

SHOP LOAD STATUS →

SHOP ORDERS, MATERIAL SHORTAGE REPORTS →

PROBLEMS →

RELEASE SCHEDULE →

PURPOSE: TO IDENTIFY POINTS IN THE SCHEDULING PROCESS WHICH MAY CAUSE OR FAIL TO ANTICIPATE SLP PAGES

VIEWPOINT: MANAGER OF PRODUCTION PLANNING AND CONTROL

NOTE	A-O	TITLE	CONTEXT	ADJUST RELEASE SCHEDULE	NUMBER
------	-----	-------	---------	-------------------------	--------

# AUTHORING PROCEDURES LAY OUT DIAGRAM

USED AT:	AUTHOR:	DATE:	WORKING	READER	DATE	CONTENT:
	PROJECT:	REV:	DRAFT	RECOMMENDED		
NOTES: 1 2 3 4 5 6 7 8 9 10						

FORECAST  
LOAD  
1

IDENTIFY  
NEEDED  
ADJUST-  
MENTS  
2

SELECT  
ORDER  
FOR  
RELEASE  
3

MODE	A0	DATE	ADJUST RELEASE SCHEDULE	NUMBER
------	----	------	-------------------------	--------

# AUTHORING PROCEDURES LAY OUT DIAGRAM

USED AT:	AUTHOR: PROJECT:	DATE: REV:	WORKING DRAFT RECOMMENDED PUBLICATION	READER	DATE	CONTENT:
NOTES: 1 2 3 4 5 6 7 8 9 10						

SHOP LOAD STATUS →

FORECAST LOAD 1

SHOP ORDERS, MATERIAL SHORTAGE REPORTS →

IDENTIFY NEEDED ADJUSTMENTS 2

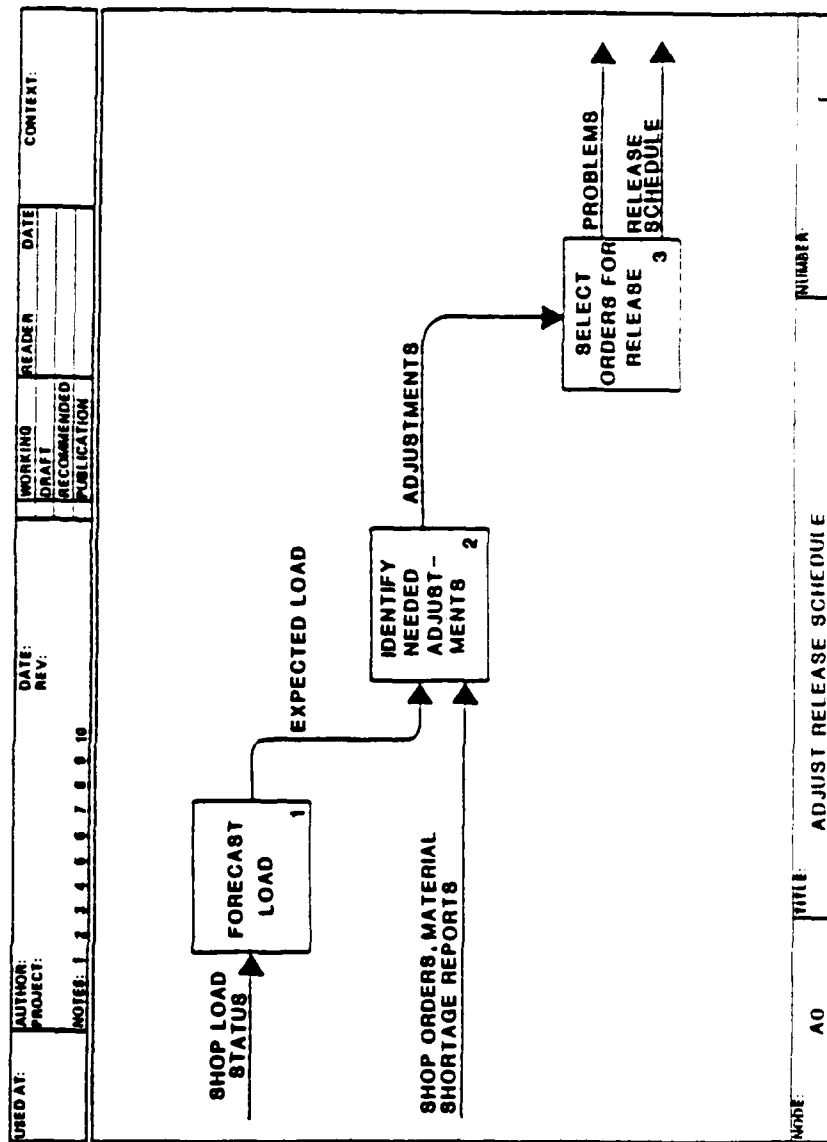
SELECT ORDERS FOR RELEASE →

PROBLEMS

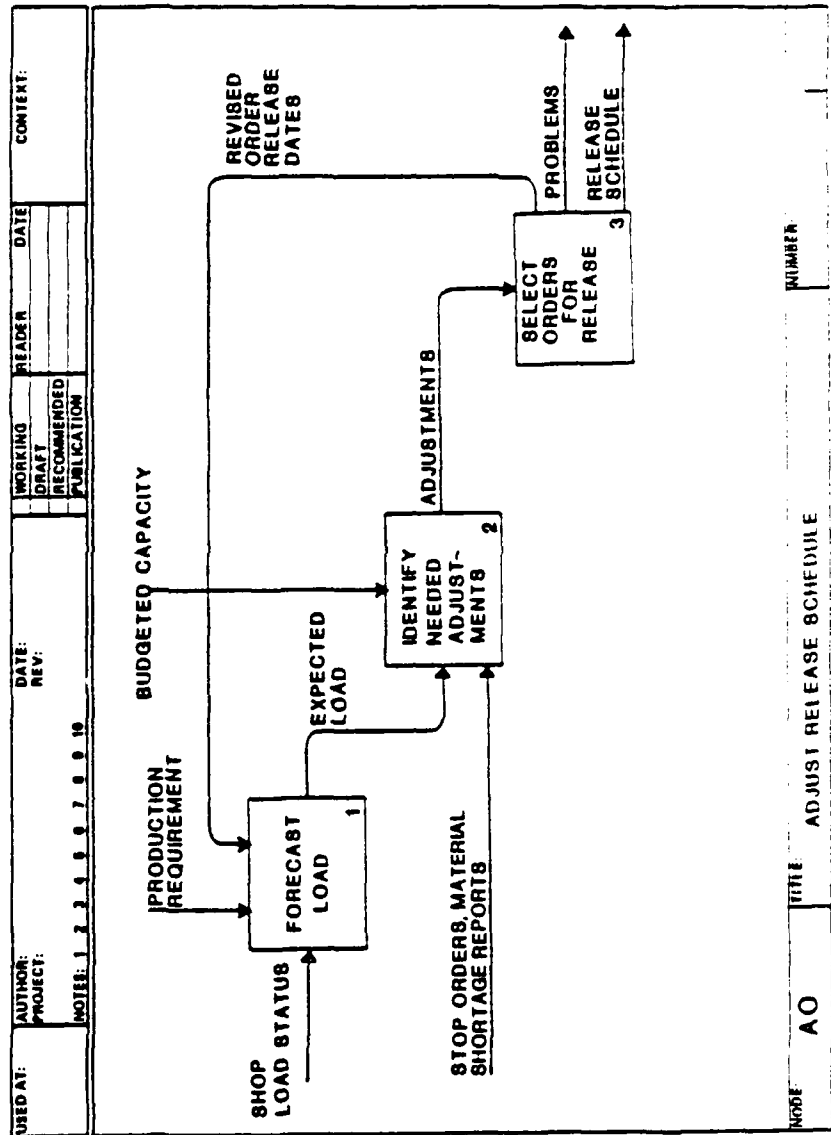
RELEASE SCHEDULE 3

MODE	A0	TITLE	ADJUST RELEASE SCHEDULE	NUMBER
------	----	-------	-------------------------	--------

# AUTHORING PROCEDURES LAY OUT DIAGRAM



# AUTHORING PROCEDURES LAY OUT DIAGRAM



## AUTHORING PROCEDURES

## REFINE LAYOUT

### ARROW LAYOUT AFFECTS READABILITY

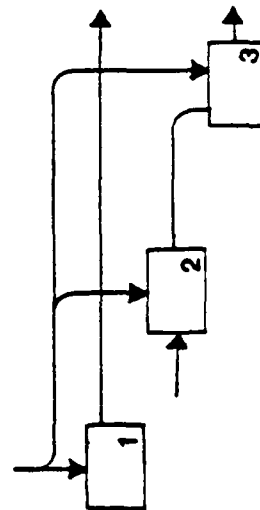
1. DRAW ARROWS ALONG VERTICAL AND HORIZONTAL LINES



2. SPACE PARALLEL ARROWS ADEQUATELY



3. PLACE ARROWS AND INTERSECTIONS A REASONABLE DISTANCE AWAY FROM BOXES AND EACH OTHER

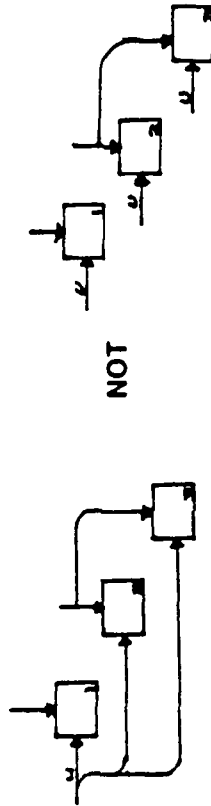




## AUTHORING PROCEDURES

## REFINE LAYOUT

4. CONNECT OPEN-ENDED (PARENT) ARROWS TO SHOW ALL THE PLACES AFFECTED



5. DON'T USE THE KEY WORDS (DATA, FUNCTION, OUTPUT, ETC.) IN LABELING ARROWS AND BOXES

## AUTHORING PROCEDURES

### REFINE LAYOUT

6. BUNDLE ARROWS WITH THE SAME SOURCE AND THE SAME DESTINATION IF AND WHEN IT IS REASONABLE



7. ON ANY SIDE OF A BOX, IT IS BETTER TO HAVE NO MORE THAN FOUR ARROWS



8. CONTROL FEED-BACKS SHOULD BE SHOWN AS "UP AND OVER"



# AUTHORING PROCEDURES REFINE LAYOUT

9. INPUT FEED-BACKS SHOULD BE SHOWN AS "DOWN AND UNDER"



10. IF AN ARROW BRANCHES AND FEEDS INTO SEVERAL BOXES, DRAW IT AT THE SAME RELATIVE POSITION



11. DON'T CROSS ARROWS IF POSSIBLE



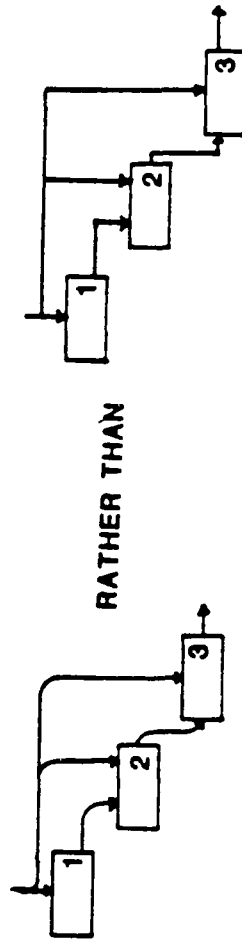
**AUTHORING  
PROCEDURES**

**REFINE LAYOUT**

**12. MINIMIZE CURVES**

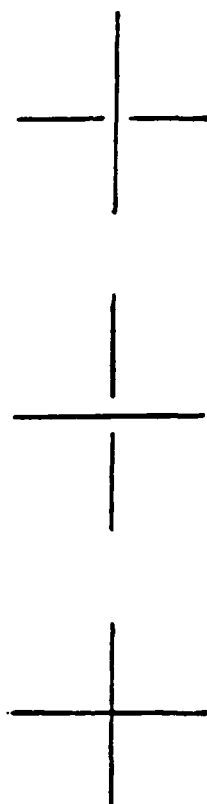


**13. ROUND CORNERS**

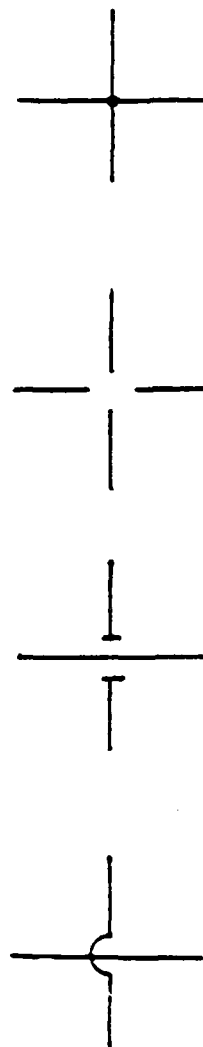


AUTHORING PROCEDURES	REFINE LAYOUT
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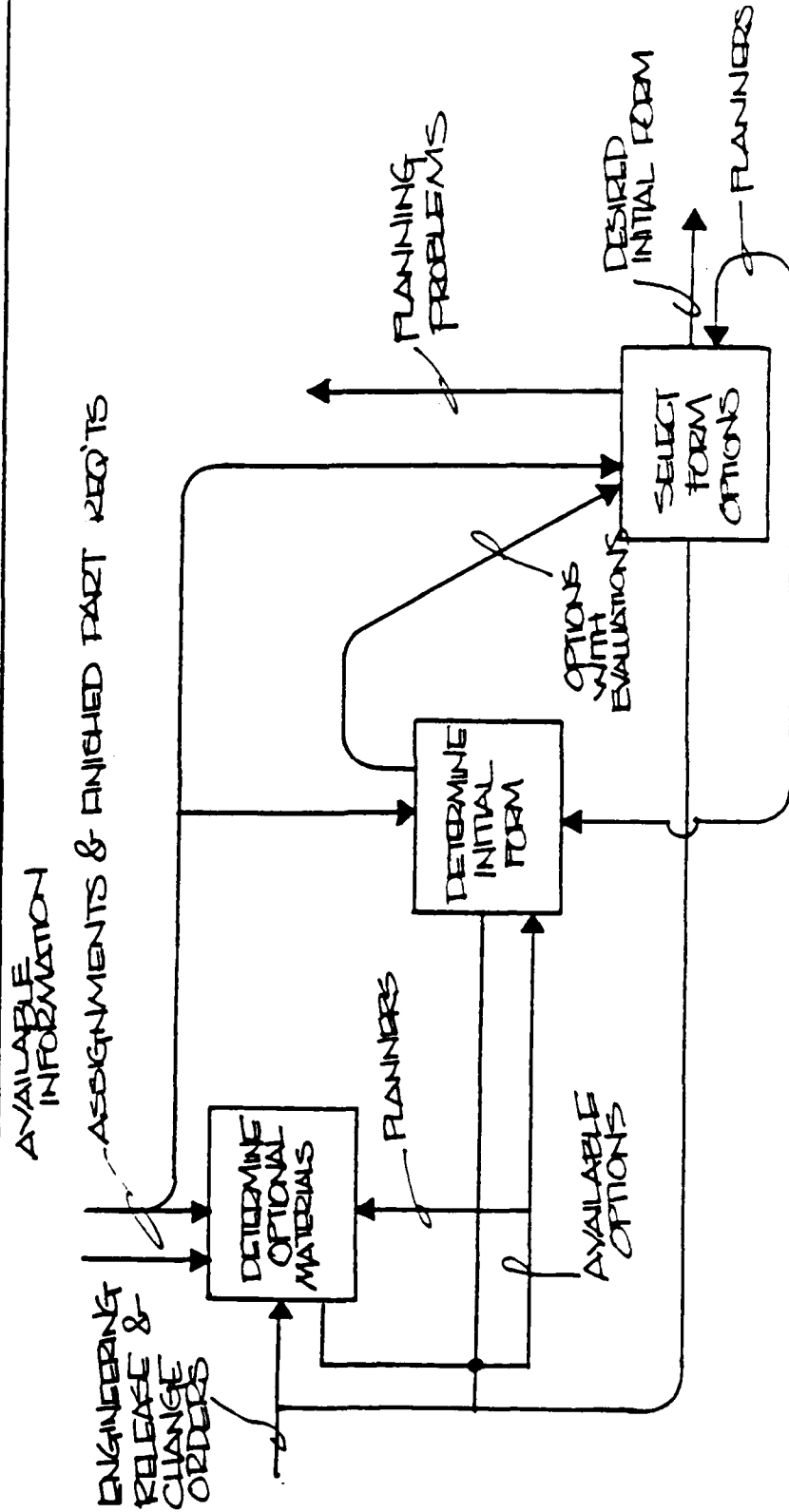
ALLOWED



NOT ALLOWED



# AUTHORING PROCEDURES REFINE LAYOUT EXERCISE



NODE	TITLE	NUMBER
	DETERMINE INITIAL FORM OF RAW MATERIALS	

# AUTHORING PROCEDURES REFINE LAYOUT EXERCISE

USED AT:	AUTHOR: PROJECT:	DATE: REV:	WORKING DRAFT RECOMMENDED PUBLICATION	READER	DATE	CONTENT:
	NOTES: 1 2 3 4 5 6 7 8 9 10					

BOOK:	TITLE:	NUMBER:
-------	--------	---------

**AUTHORING  
PROCEDURES** | **FEO (FOR EXPOSITION ONLY)**

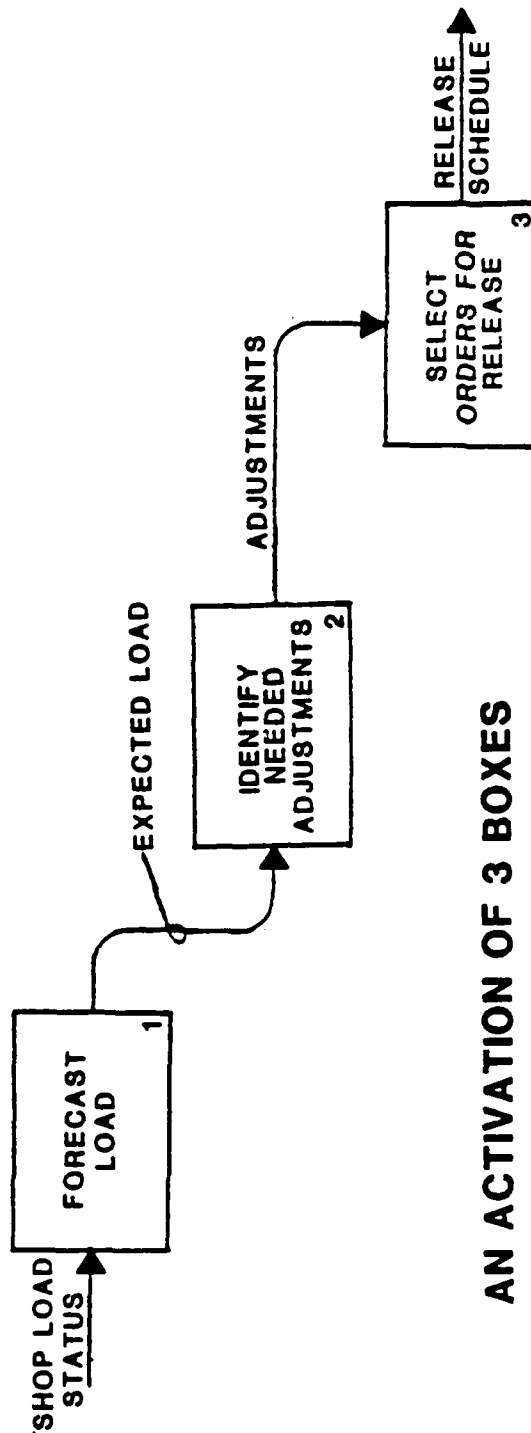
**A FEO:**

- IS USED BY THE AUTHOR
  - TO ILLUSTRATE A POINT
  - TO CLARIFY A DIAGRAM
- IS A DIAGRAM THAT FALLS OUTSIDE THE STRICT HIERARCHY
- MAY CONTAIN MORE THAN SIX BOXES AND HAVE PARTIAL ARROW STRUCTURE i.e. VIOLATE IDEFO (FUNCTION MODEL) SYNTAX
- MAY USE OTHER METHODOLOGIES i.e. PERT, CPM, etc.

FTR1104100000  
8 September 1983

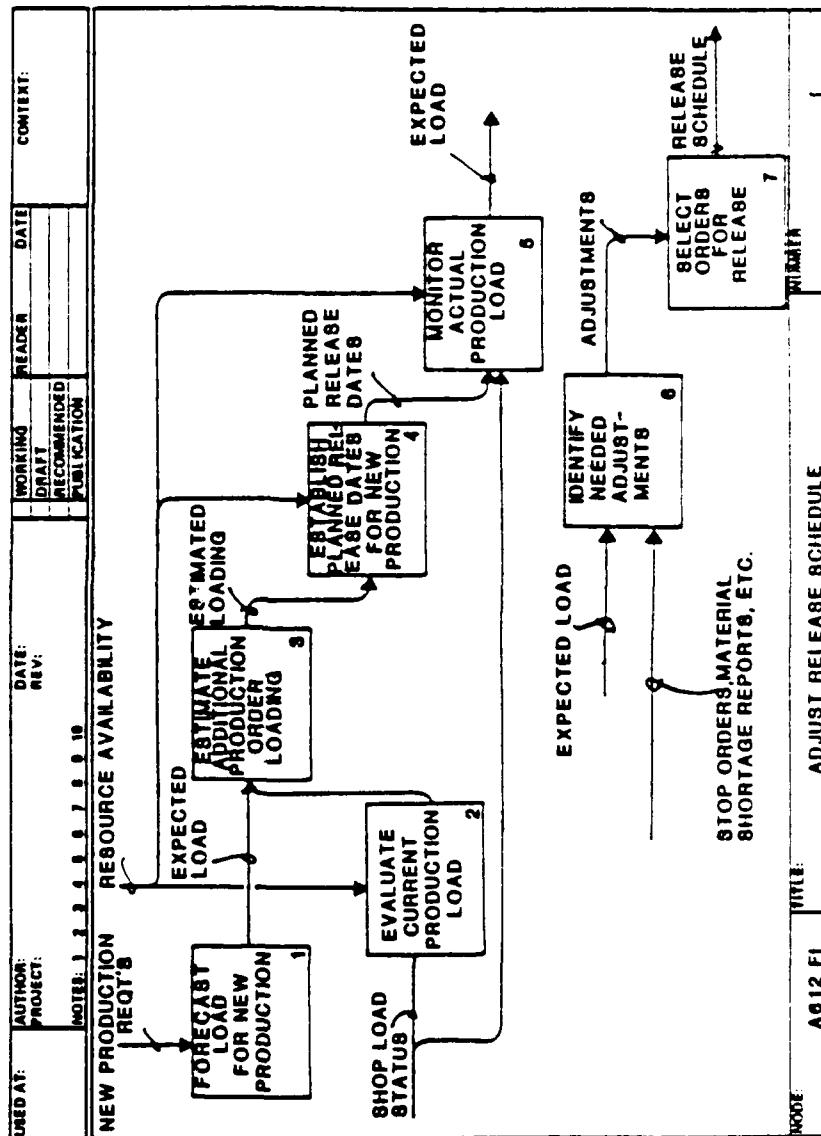


**AUTHORING PROCEDURES** | **FEO (FOR EXPOSITION ONLY) EXAMPLE**



**AN ACTIVATION OF 3 BOXES  
TO ILLUSTRATE A PARTICULAR  
SCENARIO.**

**FEO (FOR EXPOSITION ONLY) EXAMPLE**



AD-A144 732

INTEGRATED COMPUTER-AIDED MANUFACTURING (ICAM)  
ARCHITECTURE PART 3 VOLUME..(U) SOFTECH INC WALTHAM MA  
A W SNODGRASS SEP 83 1080-37

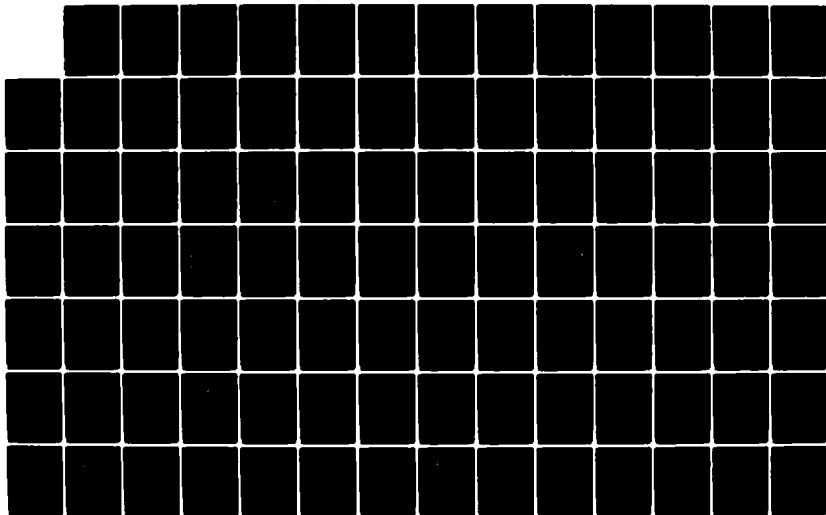
4/6

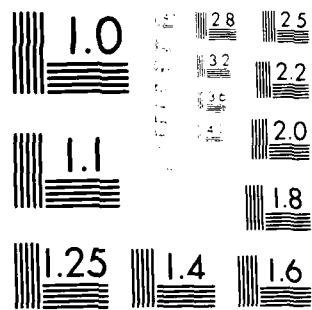
UNCLASSIFIED

AFWAL-TR-82-4063-PT-3-VOL-8

F/G 13/8

NL





MICROCOPY RESOLUTION TEST CHART  
 NATIONAL BUREAU OF STANDARDS-1963-A

# AUTHORING PROCEDURES TEXT

FTA1104100000  
5 September 1963

DATE:	AUTHOR:	DATE:	WORKING	READER	DATE	CONTENT:
	PROJECT:	REV:	DRAFT			
			RECOMMENDED			
			PUBLICATION			
NOTE: 1 2 3 4 5 6 7 8 9 10						
<p><u>TEXT</u></p> <p>A612 F1 - IS A FEO (FOR EXPOSITION ONLY) DIAGRAM REPRESENTING A CLARIFICATION VIEW OF DIAGRAM A612, ADJUST RELEASE SCHEDULE.</p> <p>THE A612 FEO SHOWS AN EXPANDED VIEW OF ADJUST RELEASE SCHEDULE FOR READER'S CLARIFICATION.</p> <p>A612 F1 - SHOWS THE STEPS INVOLVED IN ADJUSTING THE SHOP LOAD FOR ACTUAL CONDITIONS. BASED ON THE PRODUCTION REQUIREMENTS AND EXISTING LOAD, A FORECASTED LOAD IS DETERMINED ON THE SHOP TO MEET THE NEW PRODUCTIONS REQUIREMENTS.</p> <p>THESE ADJUSTMENTS TAKE THE FORM OF REVISED SCHEDULING IN THE SHOP DUE TO SHIFTING OF THE LOAD DATES, SHOP ORDERS, AND MATERIAL SHORTAGES.</p>						
CODE:	A612F1T1	TITLE:	ADJUST RELEASE SCHEDULE TEXT			NUMBER:

# AUTHORING PROCEDURES GLOSSARY

DATE:	AUTHOR:	DATE:	WORKING:	DATE:	CONTEXT:
	PROJECT:	REV:	DRAFT	READER	
			RECOMMENDED		
			PUBLICATION		
NOTE:	1 2 3 4 5 6 7 8 9 10				

**GLOSSARY:**

EXPECTED LOAD - LOAD AS FORECASTED FOR NEW PRODUCTION.

ADJUSTMENTS - ADJUSTED LOAD FOR ACTUAL NEW PRODUCTION LOAD CONDITION.

MATERIAL SHORTAGE REPORT CONSISTING OF NEW PROMISE DATES, LOT EFFECTIVITY AND WORK BREAKDOWN STRUCTURE IMPACT FOR SHORTAGE ITEMS.

RESOURCE AVAILABILITY - MANPOWER, MACHINE, EQUIPMENT, AND/OR PROCESS AVAILABILITY.

ESTIMATED LOADING - THE ESTIMATE OF SHOP LOAD CONDITIONS FOR NEW PRODUCTION ORDER LOADING.

PLANNED RELEASE DATES - DATES PLANNED FOR RELEASE OF NEW PRODUCTION ORDERS BASED ON CURRENT PRODUCTION LOAD AND FORECASTED LOAD REQUIREMENTS.

SHOP LOAD STATUS - CURRENT AVAILABILITY OF SHOP LOAD.

RELEASE SCHEDULE - SCHEDULE FOR RELEASE ORDERS FOR NEW PRODUCTION.

NEW PRODUCTION REQUIREMENTS - REQUIREMENTS FOR MANHOOURS, MATERIALS, EQUIPMENT, PROCESSES FOR NEW PRODUCTION.

MODE:	4612F1Q1	TITLE:	ADJUST RELEASE SCHEDULE GLOSSARY	NUMBER:	
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FTR2104100000  
8 September 1967

AUTHORING PROCEDURES	DECOMPOSITION
-------------------------	---------------

- AUTHOR A DIAGRAM
- VERIFY AND REFINE
- DECOMPOSE AND ITERATE

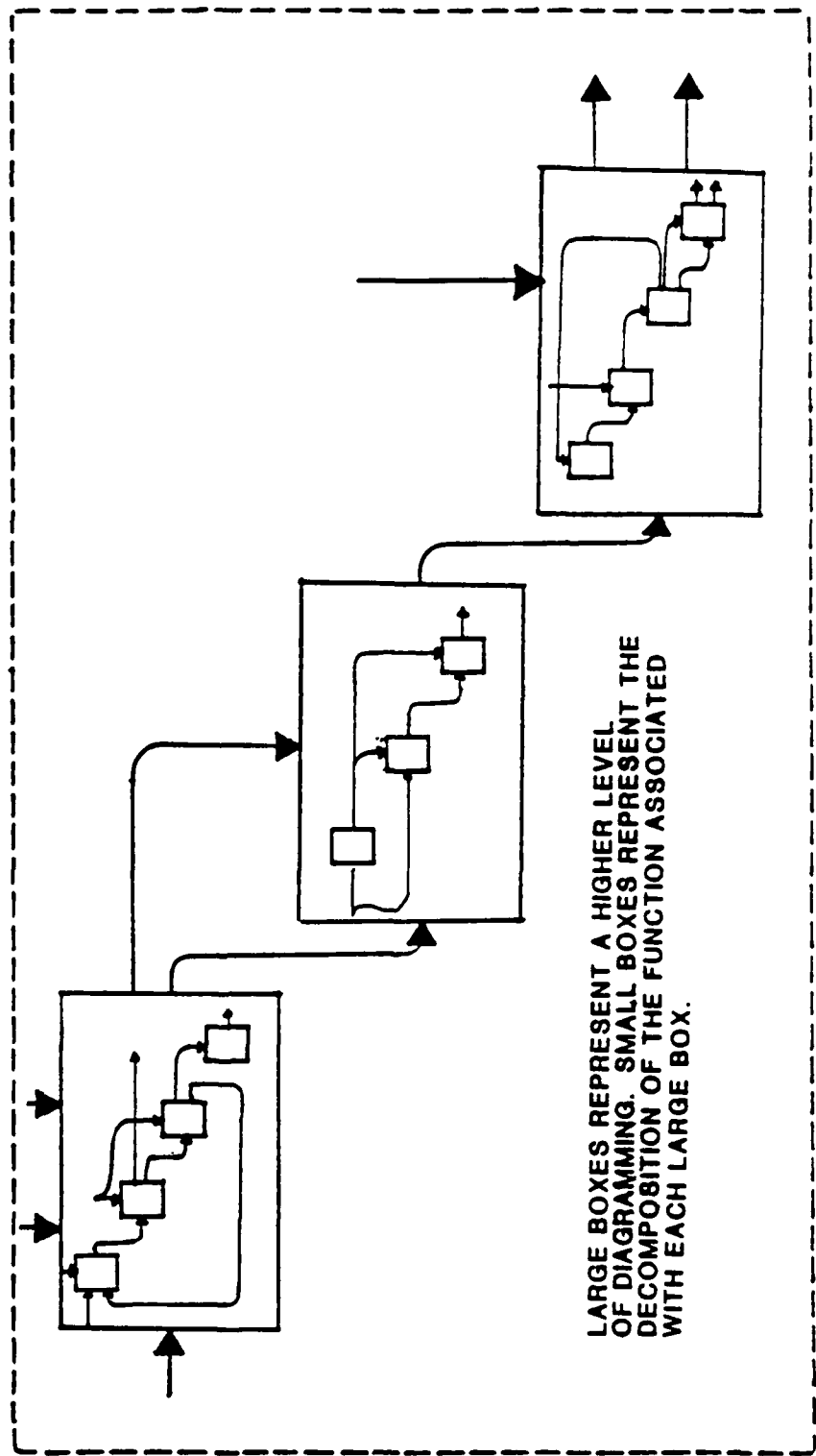
<b>AUTHORING PROCEDURES</b>	<b>DECOMPOSITION PROCESS</b>
---------------------------------	------------------------------

- CHOOSE BOX FOR DECOMPOSITION
- COLLECT DATA
- BOUND CONTEXT
- CLUSTER DATA AND FUNCTIONS
- SKETCH BOXES AND ARROWS (LAY OUT DIAGRAM)
- REFINE LAYOUT
- CONFIRM INTERFACE WITH PARENT
- SEND OUT KIT FOR REVIEW (VERIFY)



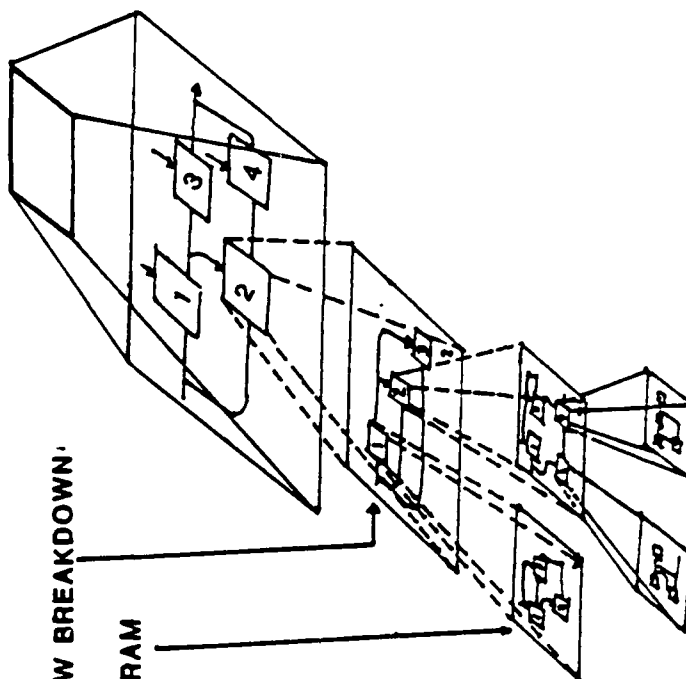
**AUTHORING  
PROCEDURES**

**DECOMPOSITION**



AUTHORING PROCEDURES	DECOMPOSITION
-------------------------	---------------

NUMBERED BOXES SHOW BREAKDOWN  
OF SINGLE BOX  
IN MORE GENERAL DIAGRAM



MORE GENERAL

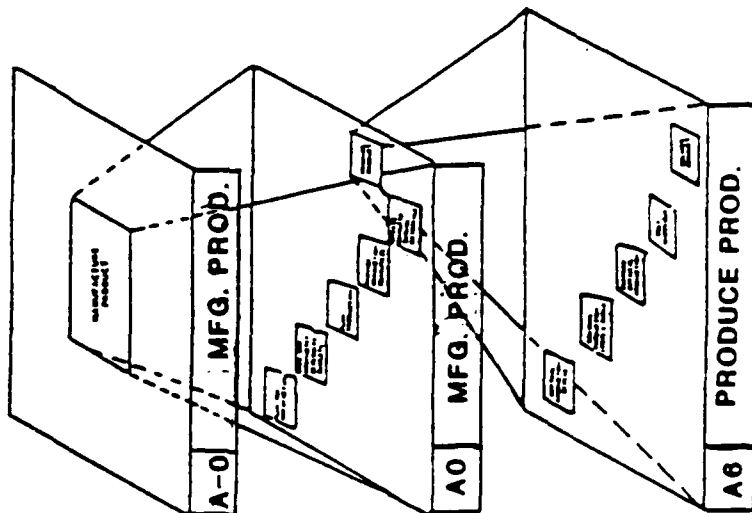


MORE DETAILED

## AUTHORING PROCEDURES

## DECOMPOSITION

A MODEL ORGANIZES DIAGRAMS INTO A  
STRUCTURED DECOMPOSITION

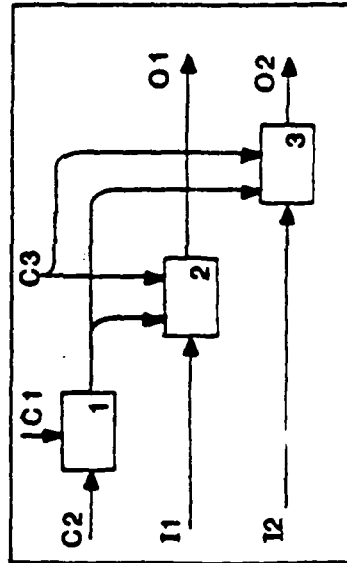
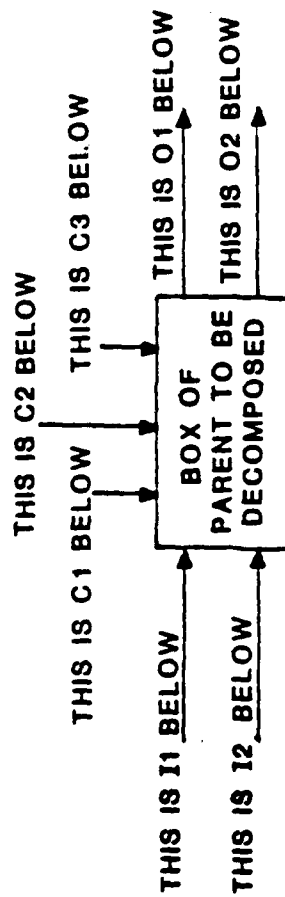


A-0 → CONTEXT

A0 → FIRST LEVEL  
OF DECOMPOSITION

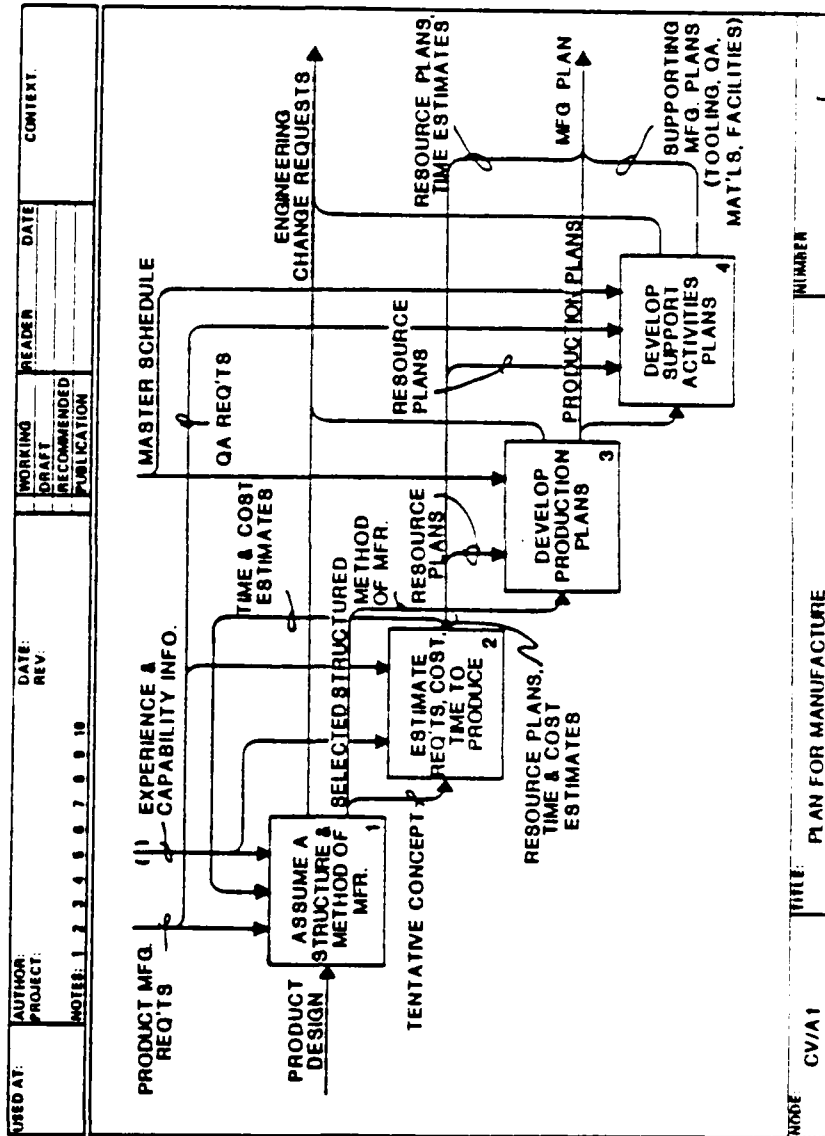
SECOND LEVEL OF DECOMPOSITION

## AUTHORING PROCEDURES DECOMPOSITION

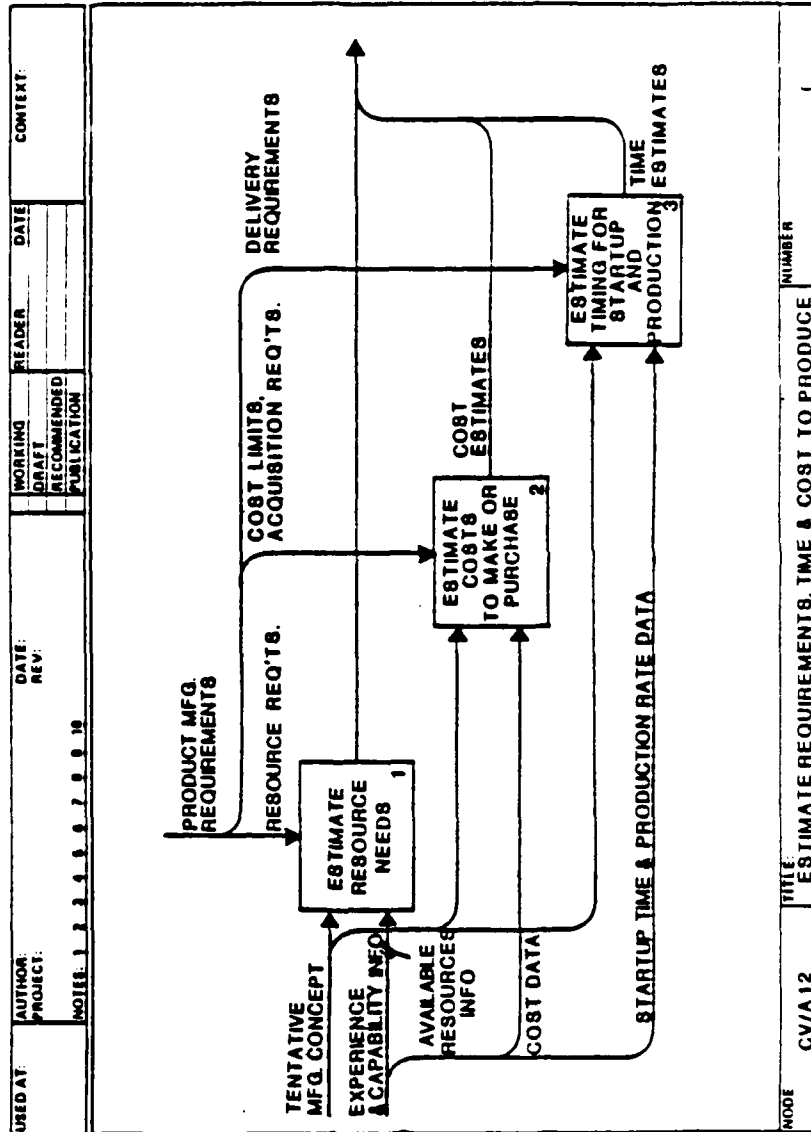


ICOM CODES ARE WRITTEN ON THE DECOMPOSED DIAGRAM  
AS THEY APPEAR ON THE PARENT DIAGRAM

# AUTHORING PROCEDURES DECOMPOSITION



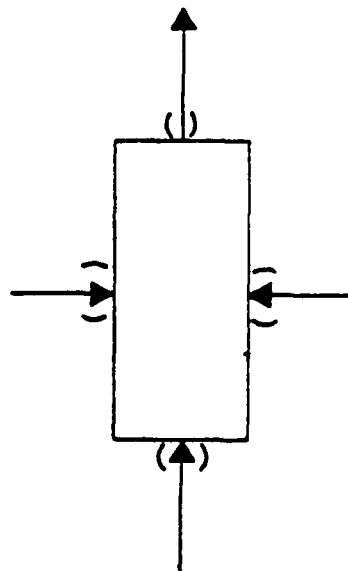
# AUTHORING PROCEDURES DECOMPOSITION



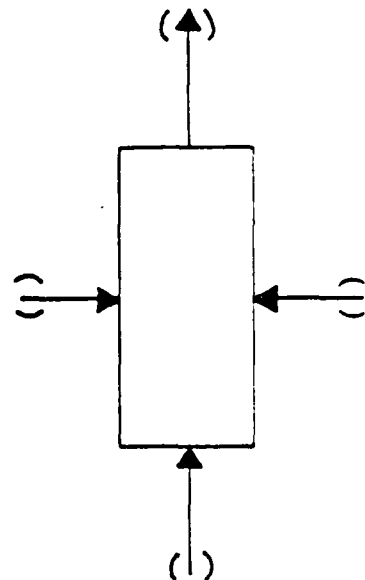
FTR1104100000  
6 September 1983

# AUTHORING PROCEDURES DECOMPOSITION

## TUNNELLED ARROWS

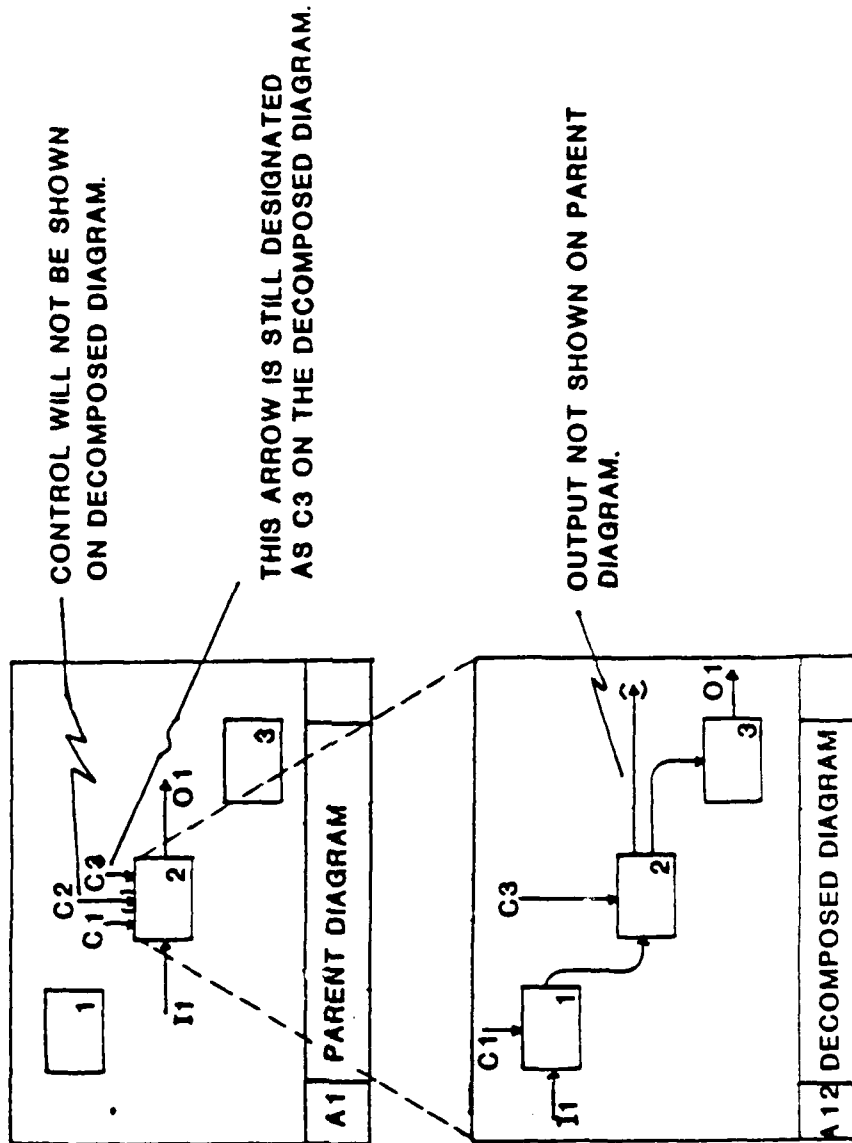


ARROW WILL NOT APPEAR  
ON DECOMPOSED DIAGRAM



ARROW WILL NOT APPEAR  
ON PARENT DIAGRAM

# AUTHORING PROCEDURES DECOMPOSITION





# AUTHORING PROCEDURES

## DIAGRAM FORM

DIAGRAM STATUS      PARENT CONTEXT

USED AT:	AUTHOR: PROJECT:	DATE: REV:	WORKING DRAFT RECOMMENDED PUBLICATION	HEADER	DATE	CONTENT
MODEL NAME AND NODE NUMBER		AUTHOR AND PROJECT NAME		CREATION DATE AND REVISION DATE		C-NUMBER (NEW&OLD)
TITLE		TITLE OF NODE		PAGE NUMBER		PAGE NUMBER

WORKING  
INFORMATION

THE  
MESSAGE  
FIELD

IDENTIFICATION  
FIELD

DIAGRAM  
TEXT  
FEO  
GLOSSARY

# AUTHORING PROCEDURES

## CONTEXT ENTRY

USED AT:	AUTHOR:	DATE:	DATE:	DATE:
PROJECT:	PROJECT:	REV:	READER:	DATE:
NUMBER: 1 2 3 4 5 6 7 8 9 10			WORKING	
			DRAFT	
			RECOMMENDED	
			PUBLICATION	
				A32
				4

NODE OF  
PARENT NUMBER

○ = BOXES IN PARENT NOT BEING DECOMPOSED

□ = BOX BEING DECOMPOSED

CONTEXT FOR

A-0=NONE  
A0=TOP

A324

# AUTHORING PROCEDURES

## NODE NUMBER ENTRY

### COMPOSED OF

- MODEL NAME
- NUMBER OF SPECIFIC NODE

MODEL: MFG/A0	TITLE: ADJUST RELEASE SCHEDULE	NUMBER:
---------------	--------------------------------	---------

### IDENTIFIES TYPE OF PAGE

- DIAGRAM
- TEXT
- GLOSSARY
- FEO

MODEL: MFG/A0T	TITLE: ADJUST RELEASE SCHEDULE	NUMBER:
----------------	--------------------------------	---------

MODEL: MFG/A0G	TITLE: ADJUST RELEASE SCHEDULE	NUMBER:
----------------	--------------------------------	---------

MODEL: MFG/A0F	TITLE: ADJUST RELEASE SCHEDULE	NUMBER:
----------------	--------------------------------	---------

## AUTHORING PROCEDURES C-NUMBER ENTRY

CREATION NUMBER IS REFERRED TO AS C-NUMBER

COMPOSED OF

- TWO OR THREE LETTERS OF AUTHOR'S INITIALS
- FOLLOWED BY A NUMBER SEQUENTIALLY ASSIGNED BY AUTHOR

PRIMARY MEANS OF REFERENCE TO A SHEET FOUND IN THE LOWER LEFT CORNER  
OF THE NUMBER FIELD

MODE:	TITLE:	NUMBER: CM 16
-------	--------	------------------

IF A DIAGRAM REPLACES A PREVIOUS DIAGRAM, THE ORIGINAL C-NUMBER IS WRITTEN IN  
PARENTHESES FOLLOWING THE NEW C-NUMBER.

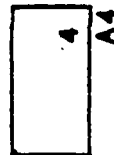
MODE:	TITLE:	NUMBER: CM22(CM16)
-------	--------	-----------------------

AUTHORING PROCEDURES	REFERENCE EXPRESSION
-------------------------	----------------------

TO FIND THE DETAILS OF A BOX, USE THE REFERENCE EXPRESSION TO IDENTIFY THE NODE NUMBER OF THE DECOMPOSED BOX.

REFERENCE EXPRESSION APPEARS

- OUTSIDE THE BOX
- BELOW THE BOX NUMBER



IF NO REFERENCE APPEARS, THE BOX HAS NOT YET BEEN DECOMPOSED.

# AUTHORING PROCEDURES DOCUMENTATION- NODE INDEX

## NODE INDEX

A-0 MANUFACTURE PRODUCT (CONTEXT)

A0 MANUFACTURE PRODUCT

A1 PLAN FOR MANUFACTURE

A11 ASSUME A STRUCTURE AND METHOD OF MANUFACTURE

A12 ESTIMATE REQUIREMENTS, TIME, AND COST TO PRODUCE

A13 DEVELOP PRODUCTION PLANS

A14 DEVELOP SUPPORT ACTIVITIES PLANS

A2 MAKE AND ADMINISTER SCHEDULES AND BUDGETS

A21 DEVELOP MASTER SCHEDULE

A22 DEVELOP COORDINATING SCHEDULES

A23 ESTIMATE COSTS AND MAKE BUDGETS

A24 MONITOR PERFORMANCE TO SCHEDULE AND BUDGET

A3 PLAN PRODUCTION

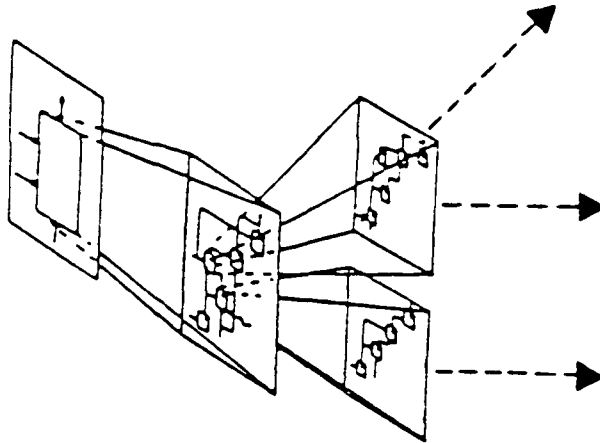
A31 CONTROL PLANNING

A32 DETERMINE DETAILED METHOD OF MANUFACTURE

A33 DEVELOP PRODUCTION INSTRUCTIONS

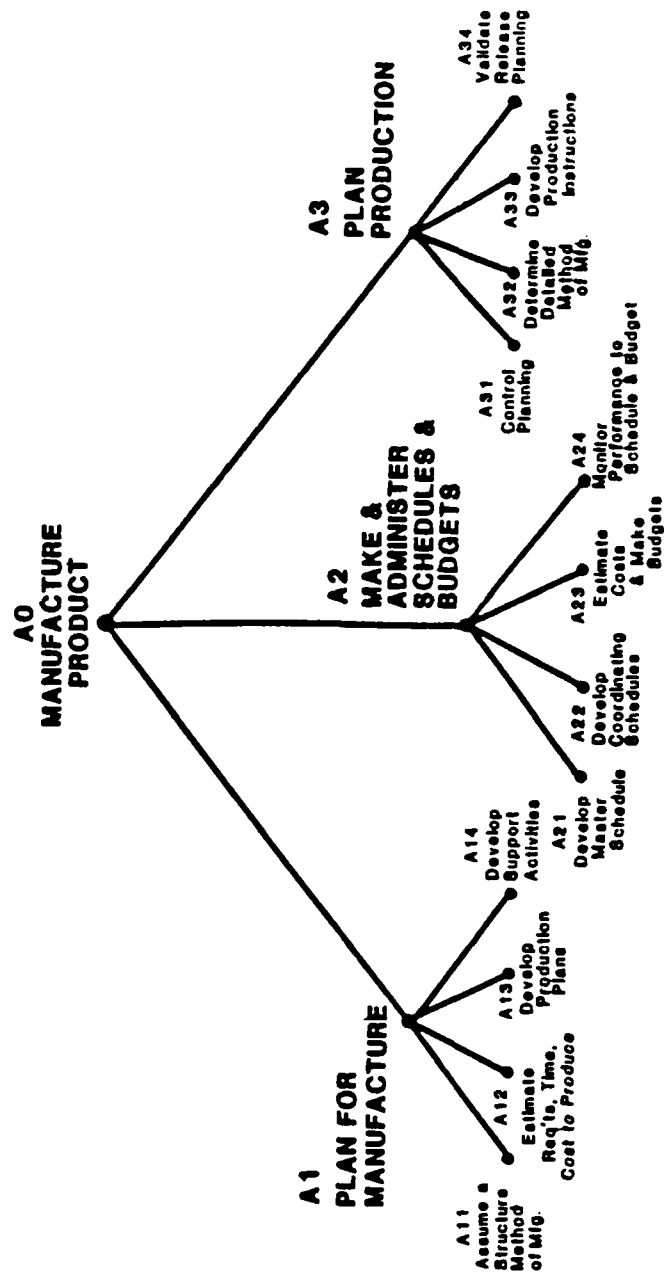
A34 VALIDATE RELEASE PLANNING

## CORRESPONDING DECOMPOSITION STRUCTURE



FTR1104100001  
8 September 1983

# AUTHORING PROCEDURES - NODE TREE



FTR1104100000  
8 September 1983

**AUTHORING CONCEPTS  
AND PROCEDURES**

**AUTHORING EXERCISE**

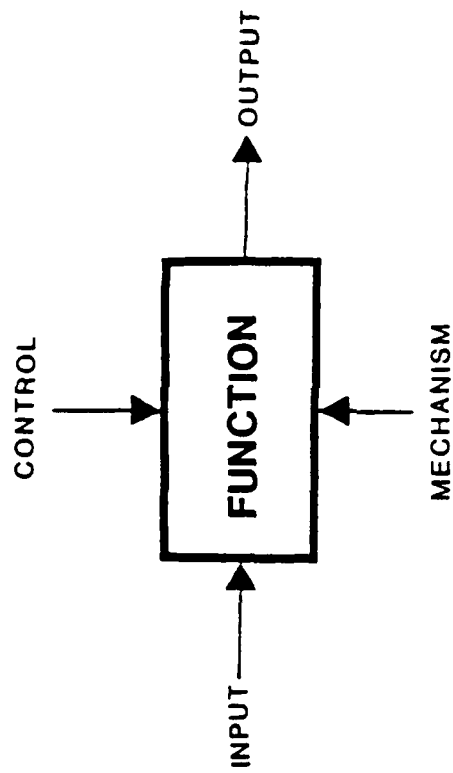
BASED ON THE FOLLOWING MODEL PURPOSE AND VIEWPOINT, CREATE AN  
A-O AND AO DIAGRAM OF YOUR JOB.

PURPOSE: TO UNDERSTAND AND COMMUNICATE THE FUNCTION OF MY JOB  
(PUT YOUR JOB IN PERSPECTIVE BY IDENTIFYING THE ORGANIZATION(S)  
YOU ARE PART OF.)

VIEWPOINT: "MYSELF" (STATE YOUR BACKGROUND AND EXPERIENCE)



IDEF<sub>0</sub>



COMMENTING  
CONCEPTS AND PROCEDURES

**COMMENTING  
CONCEPTS &  
PROCEDURES**

**LEARNING OBJECTIVES**

1. UNDERSTAND THE IMPORTANCE OF IDEF COMMENTING
2. UNDERSTAND THE IDEF KIT CYCLE
3. UNDERSTAND THE IDEF WALKTHROUGH MEETING PROCESS
4. UNDERSTAND THE IDEF LIBRARY FUNCTIONS

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8 September 1983

COMMENTING CONCEPTS	COMMENTING
------------------------	------------

**PRINCIPLES OF COMMENTING:**

- 1. UNDERSTANDING: WHAT IS THE AUTHOR SAYING ?**
- 2. AGREEMENT : DO I AGREE WITH THE AUTHOR?**

COMMENTING  
CONCEPTS

COMMUNICATION

# AUTHORING + COMMENTING = COMMUNICATION

# IDEF KIT

2-303

## COMMENTING CONCEPTS

## IDEF DIAGRAM COMMENTING PROCESS

### ASPECTS TO LOOK FOR:

- CLARITY
- CONSISTENCY
- CORRECT SYNTAX
- CORRECT SEMANTICS

**COMMENTING  
PROCEDURES**

---

**IDEF DIAGRAM COMMENTING PROCESS**

MECHANICS

- (N) NOTES
- NOTE FIELD
- USE RED INK

ABOVE ALL → MAKE COMMENTS

- CLEAR
- BRIEF
- CONSTRUCTIVE

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8 September 1977

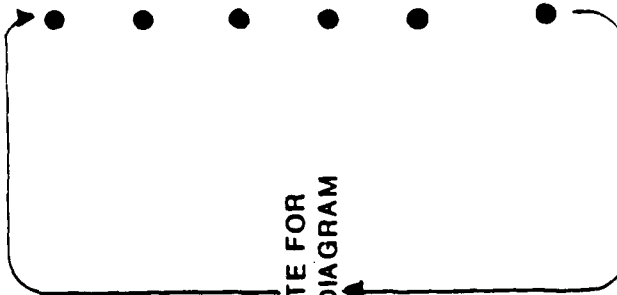
## COMMENTING PROCEDURES

### IDEF DIAGRAM COMMENTING PROCESS

#### PROCESS STEPS:

- INITIAL AND DATE KIT
- CHECK SYNTAX AND LAYOUT OF DIAGRAM
- READ DIAGRAM
- CHECK SEMANTICS OF DIAGRAM
- CHECK SUGGESTIONS DOCUMENTATION  
(e.g. FEO'S, TEXT, AND / OR GLOSSARY)
- MAKE CONSTRUCTIVE SUGGESTIONS

ITERATE FOR  
EACH DIAGRAM



FTF110410000  
8 September 1983



**COMMENTING  
CONCEPTS**

**TEXT/GLOSSARY COMMENTING**

TEXT/GLOSSARY SHOULD HAVE :

- BREVITY
- STRUCTURE
- CLARITY

TEXT/GLOSSARY SHOULD BE WRITTEN :

- TO CLARIFY INFORMATION  
CONVEYED BY THE DIAGRAM

## COMMENTING CONCEPTS

### FEO COMMENTING

A FEO (FOR EXPOSITION ONLY):  
DON'T FORGET! A FEO:

- IS ANY DIAGRAM THAT FALLS OUTSIDE THE STRICT HIERARCHY
- MAY CONTAIN MORE THAN SIX BOXES AND HAVE PARTIAL ARROW STRUCTURE
- IS USED BY THE AUTHOR
  - TO ILLUSTRATE A POINT
  - TO CLARIFY A DIAGRAM

A FEO ASKS:

- DO YOU UNDERSTAND ?
- DOES IT CLARIFY INFO FOR YOU ?
- DO YOU AGREE ?

**COMMENTING  
CONCEPTS**

**APPROACHES TO COMMENTING**

- **IDEF KIT CYCLE**
- **IDEF WALKTHROUGH  
MEETING(S)**

**COMMENTING  
PROCEDURES**

**COMMENTING**

USING KIT CYCLE AND WALKTHROUGH MEETING(S) :

- CIRCULATE KITS THROUGH KIT CYCLE

AND / OR

- CONDUCT PERIODIC WALKTHROUGH MEETING(S)

## COMMENTING PROCEDURES

## COMMENTING

### KIT CYCLING ALTERNATIVES:

- MAILING
- PERSONNEL MEETING

### PRO'S AND CON'S

### KIT CYCLE:

- SAVES TRAVEL COSTS
- GOOD FOR INITIAL CONTACT
- SLOWER COMMENTING TURN-OVER TIME
- SLOWER TO GAIN CONSENSUS

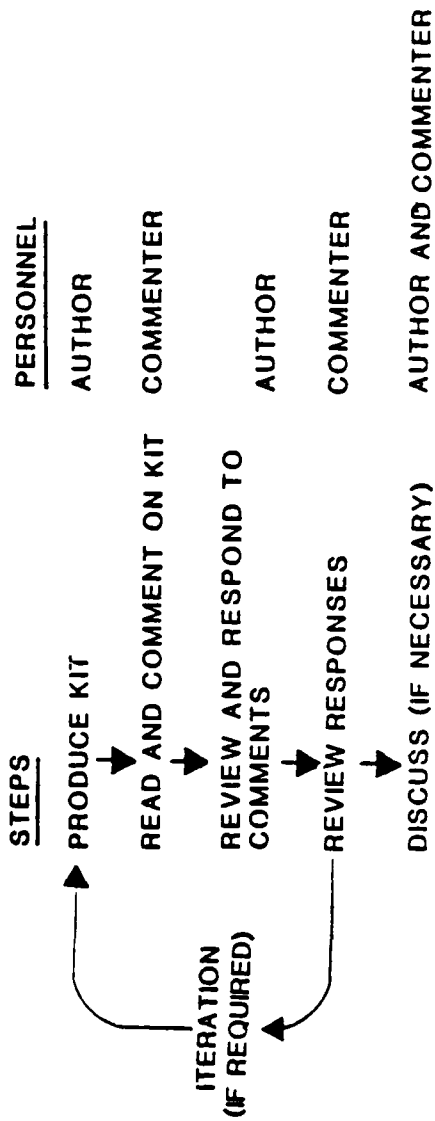
### WALKTHROUGH MEETING(S):

- QUICKER COMMENTING TURN -OVER TIME
- QUICKER TO GAIN CONSENSUS
- MORE TRAVEL COSTS
- GOOD FOR KIT FINALIZATION

FR1104100001  
6 September 1997

# COMMENTING CONCEPTS

## IDEF KIT CYCLE STEPS AND PERSONNEL



COMMENTING PROCEDURES	IDEF KIT CYCLE DISCUSSION
--------------------------	------------------------------

DISCUSSION RULES

- ONLY IF NECESSARY
- DISCUSS POINTS OF DISAGREEMENT ONLY
- LIMIT TIME
- DECIDE ACTIONS
- RECORD RESULTS

## COMMENTING PROCEDURES

## IDEF KIT CYCLE AUTHOR RESPONDING

### AUTHOR RESPONDS TO ALL COMMENTS

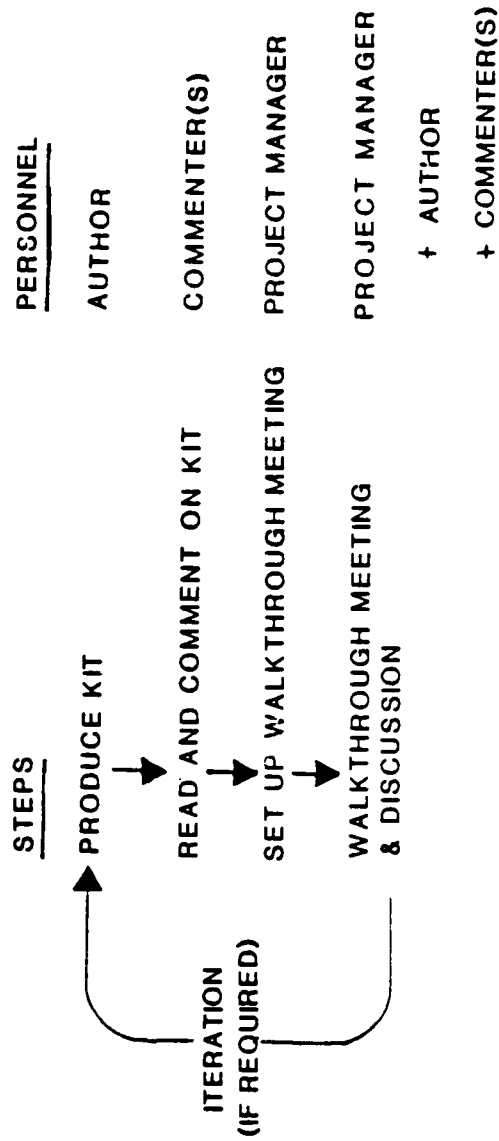
- UNDERSTAND COMMENTS
- "✓" IF AGREE
- "X" IF DISAGREE WITH EXPLANATION
- USE BLUE INK
- NOTE "LET'S TALK" - IF NECESSARY
- NOTE COMMENTS ON AUTHOR COPY
- RETURN KIT TO COMMENTER

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8 September 1967



# WALKTHROUGH MEETING STEPS AND PERSONNEL

## COMMENTING PROCEDURES



**COMMENTING**  
**PROCEDURES**

**IDEF DIAGRAM**  
WALKTHROUGH PROCESS

SIX STEPS:

1. SCAN THE DIAGRAM
2. LOOK AT THE PARENT DIAGRAM
3. CONNECT THE PARENT BOX AND THE DETAIL DIAGRAM
4. EXAMINE THE INTERNAL ARROW PATTERN
5. READ THE TEXT AND GLOSSARY
6. SET THE STATUS OF THE DIAGRAM

<b>COMMENTING PROCEDURES</b>	<b>IDEF KIT CYCLE ITERATION</b>
----------------------------------	-------------------------------------

AUTHOR REFINES DIAGRAM AND ITERATES

- INCORPORATES NECESSARY CHANGES
- ISSUES SUBSEQUENT KIT
- COMMENTERS REFER TO PREVIOUS KIT  
TO EVALUATE CHANGES

**COMMENTING  
CONCEPTS &  
PROCEDURES**

**LIBRARY FUNCTION**

WHETHER YOU USE IDEF KIT CYCLE OR  
WALKTHROUGH MEETING PROCESS  
(OR BOTH)-

YOU MUST HAVE SOME LEVEL OF  
CONTROL FOR IDEF MODELING  
TO MANAGE THE COMMUNICATION PROCESS

**COMMENTING  
PROCEDURES**

**IDEF KIT CYCLE  
LIBRARY FUNCTIONS**

- MAINTAINS FILES
- CONTROLS DISTRIBUTION OF DOCUMENTED INFORMATION
- RECEIVES, COPIES, DISTRIBUTES, TRACKS AND TRANSFERS

FTR1104100000  
8 September 1963

**COMMENTING  
CONCEPTS &  
PROCEDURES**

**COMMENTING EXERCISE**

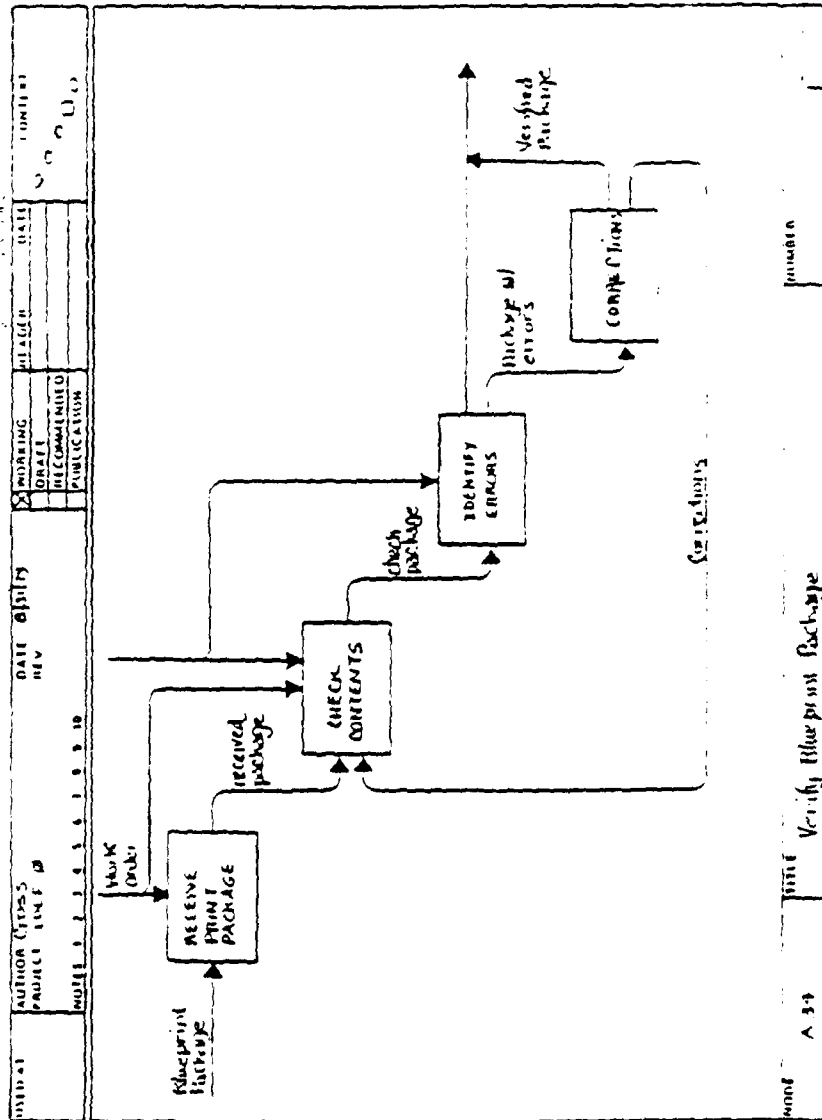
YOU PLAY THE ROLE OF A COMMENTER  
AND LOOK FOR:

- SYNTAX ERRORS  
(IDEE, SYMBOLOGY AND RULES)
- SEMANTIC ERRORS  
(MISUNDERSTANDINGS OF THE  
INTENDED AUTHOR COMMUNICATION)
- DISAGREEMENTS WITH THE AUTHOR  
(AFTER YOU UNDERSTAND WHAT  
AUTHOR INTENDED)

THEN NOTE YOUR COMMENTS ON THE DIAGRAM FOLLOWING  
THE GUIDELINES JUST PROVIDED

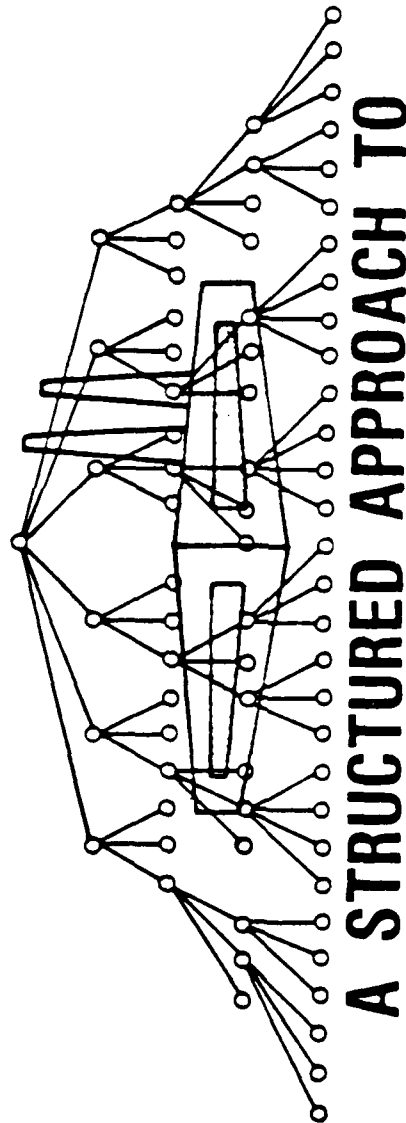
FTR1104100000  
8 September 1963

## IDEF KIT CYCLE COMMENTING EXERCISE



# ARCHITECTURE

---

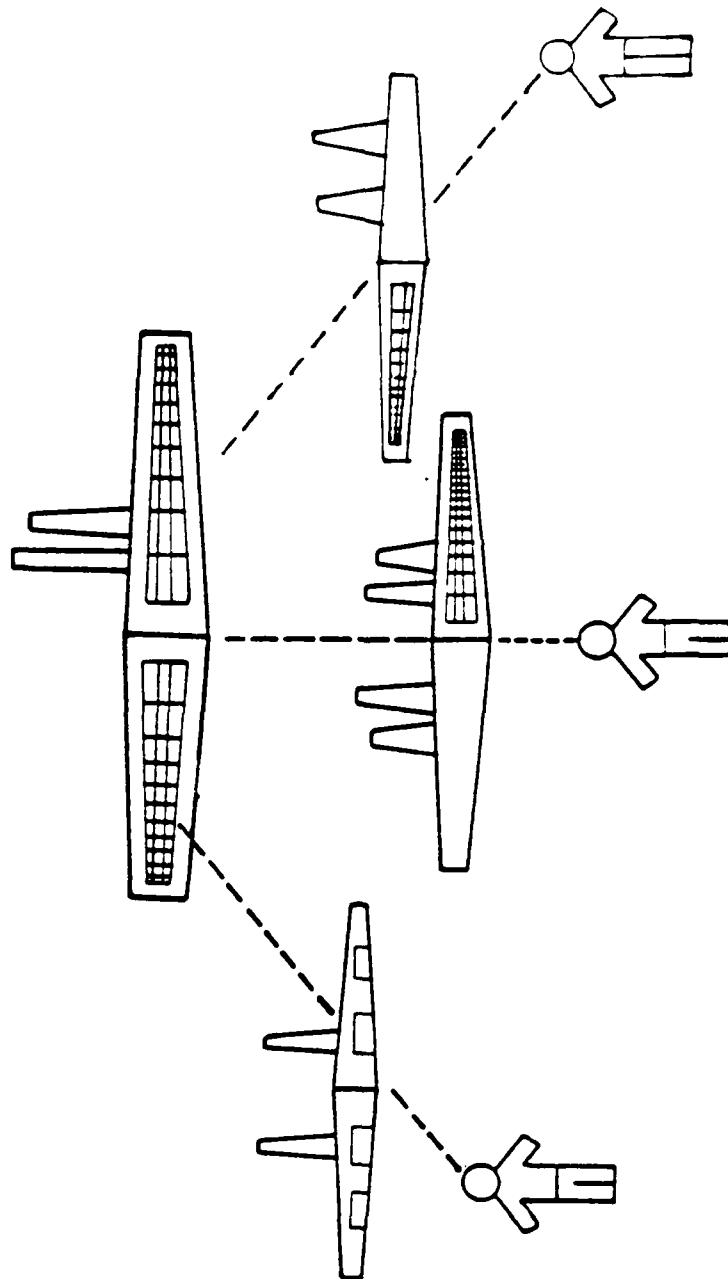


## A STRUCTURED APPROACH TO

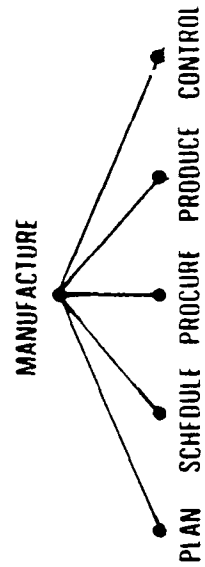
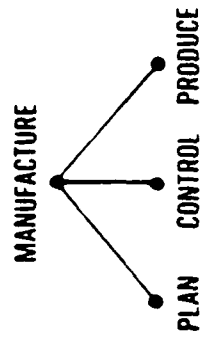
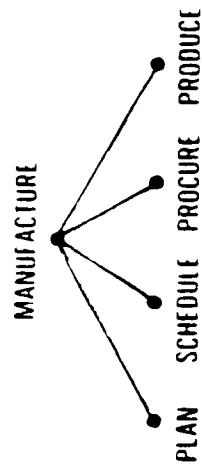
## MANUFACTURING



# STANDARD FOR COMMUNICATION



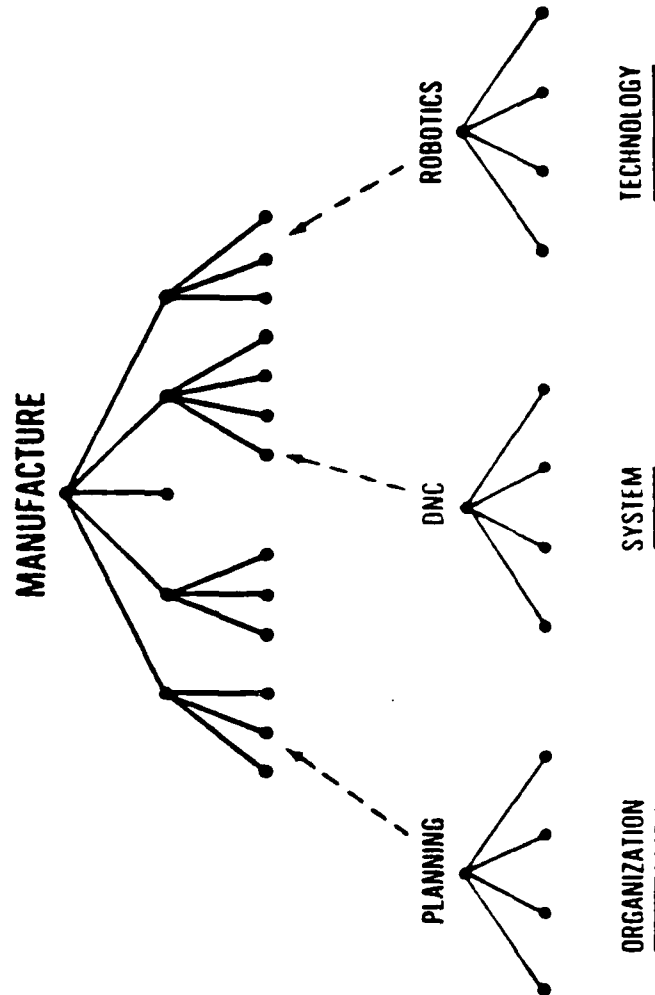
# STANDARD FOR COMMUNICATION



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8 September 1963

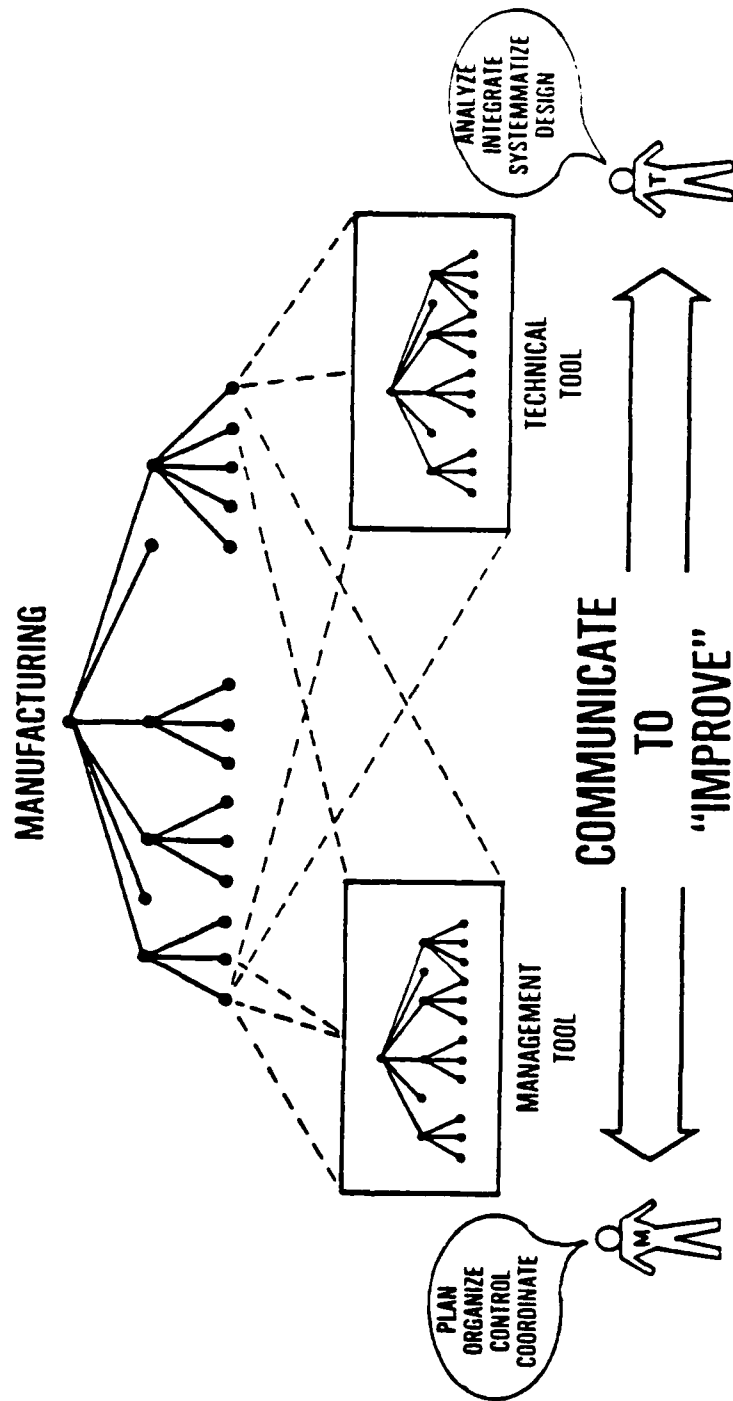
# STANDARD FOR COMMUNICATION

---



FTR1104100000  
8 September 1983

# USES OF ARCHITECTURE



Final Version  
5 September 1987

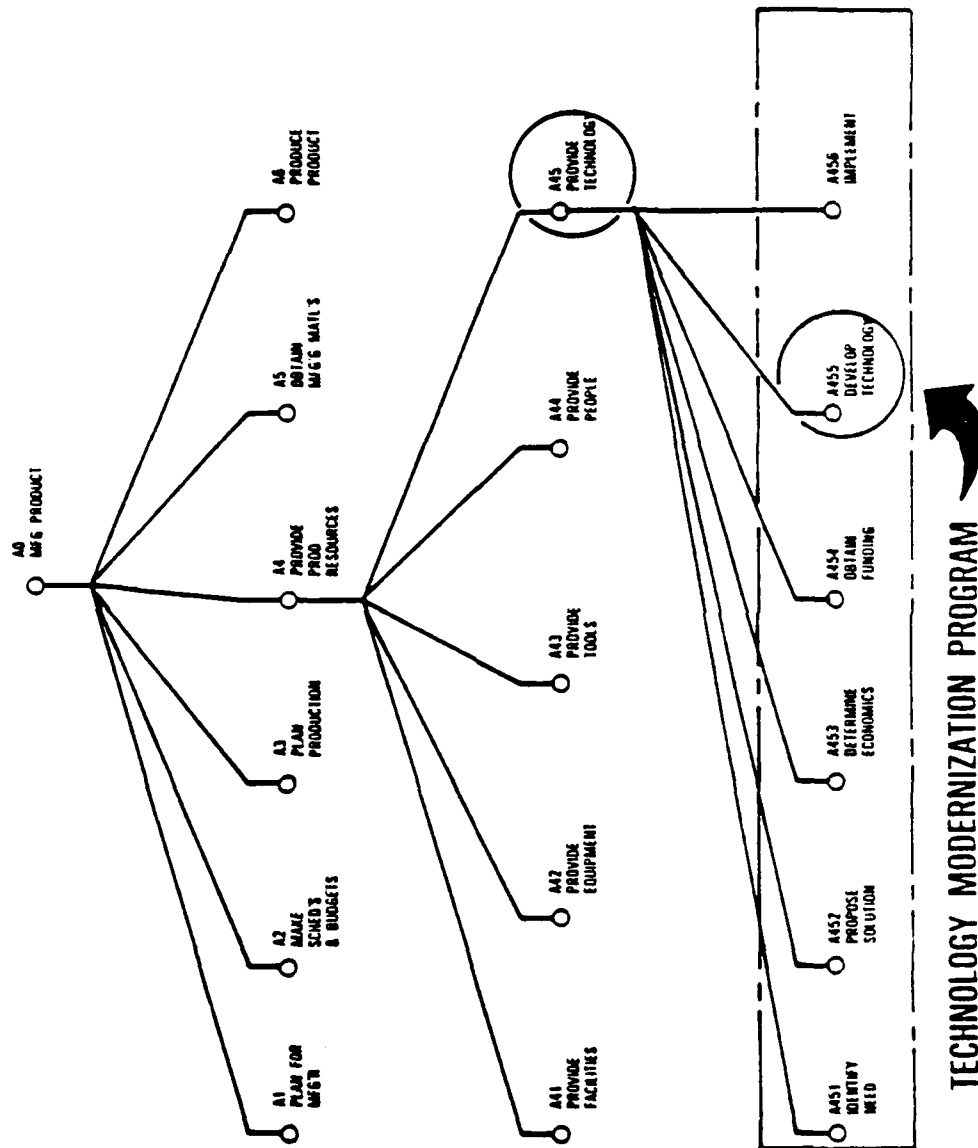
# MANAGEMENT TOOL

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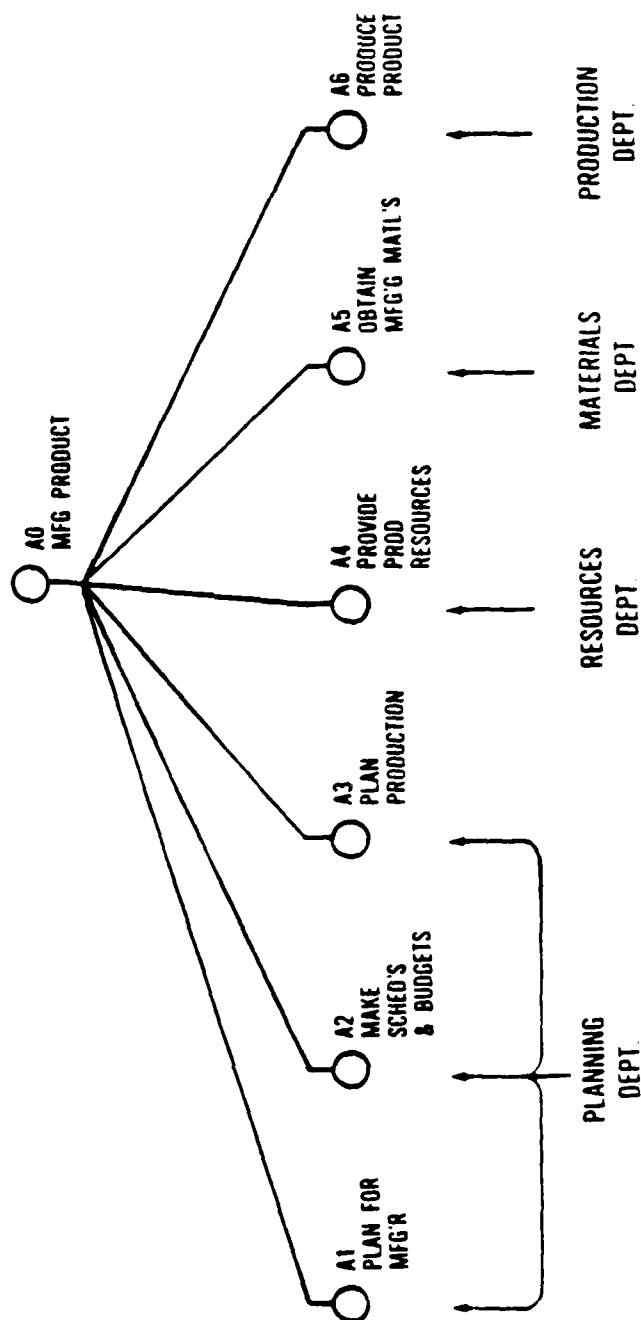
- PRESENTATION MEDIUM
- ORGANIZATIONAL STRUCTURE
- PLANNING VEHICLE
- PROGRAM MANAGEMENT

FTR1104100000  
8 September 1983

# PRESENTATION MEDIUM

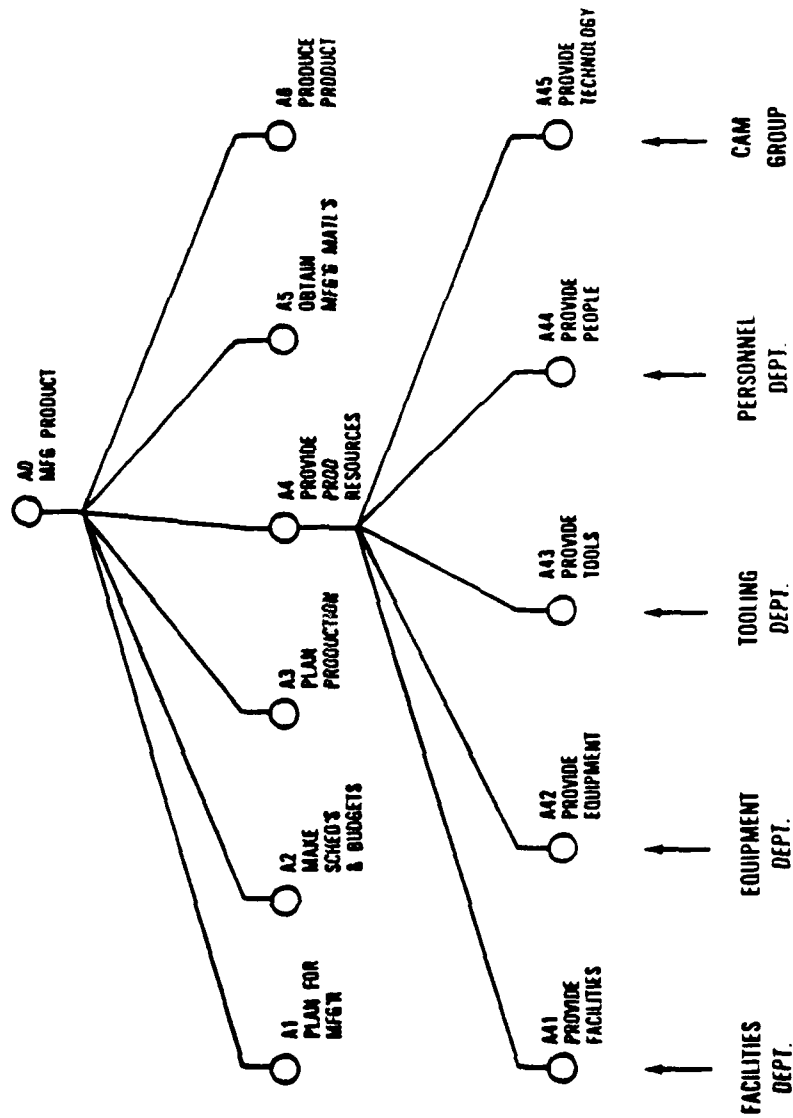


# ORGANIZATIONAL STRUCTURE



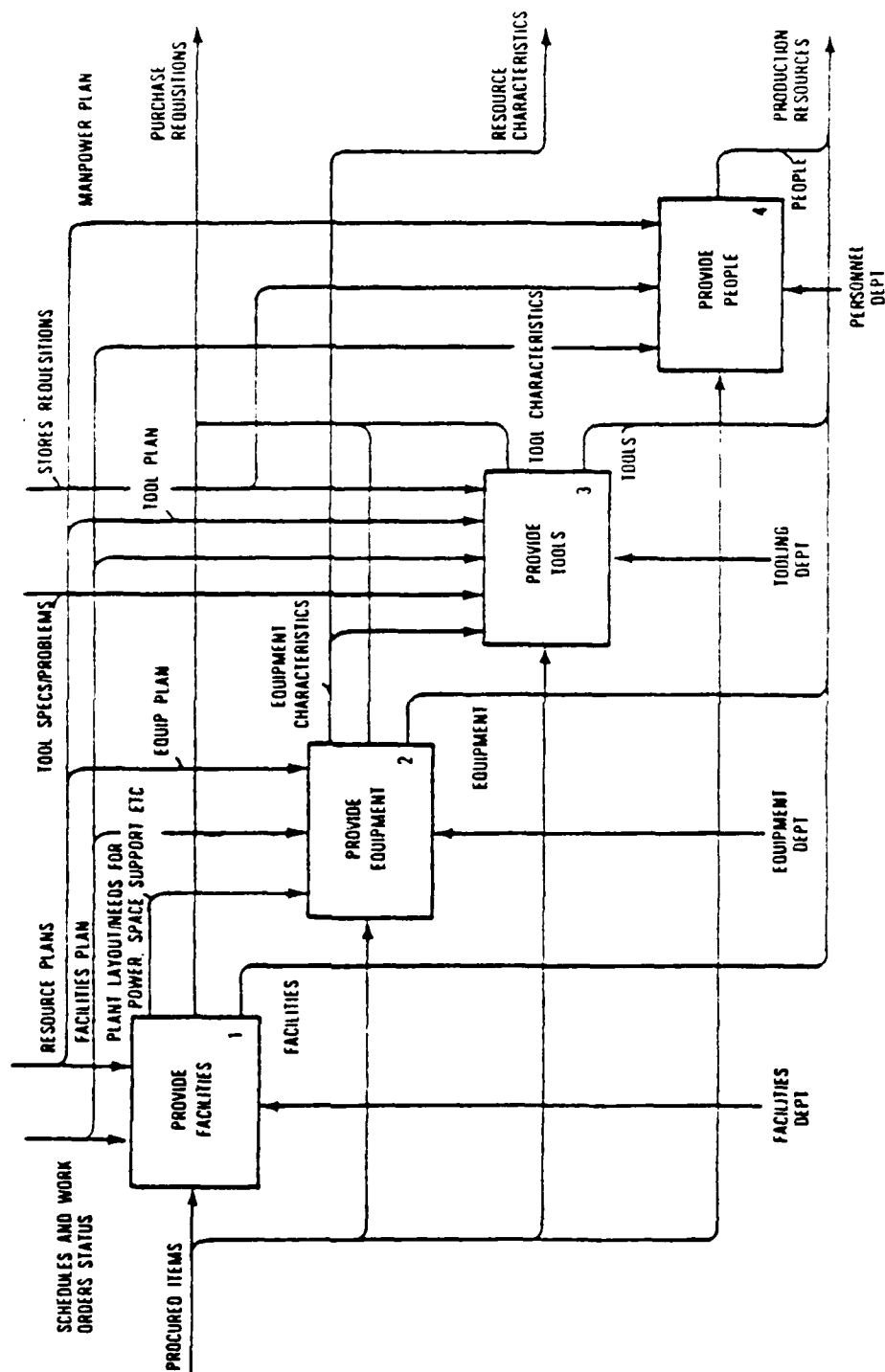
FTB11041001001  
September 1967

# ORGANIZATIONAL STRUCTURE

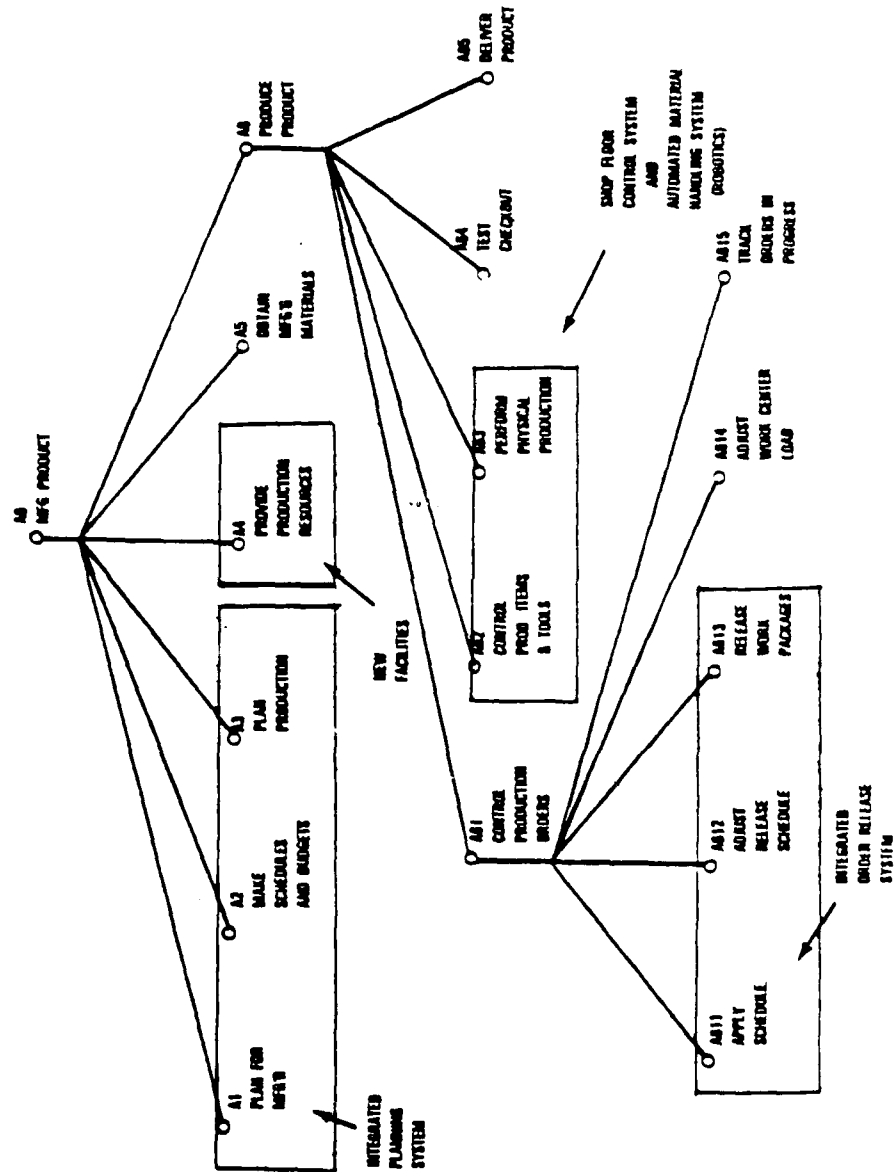




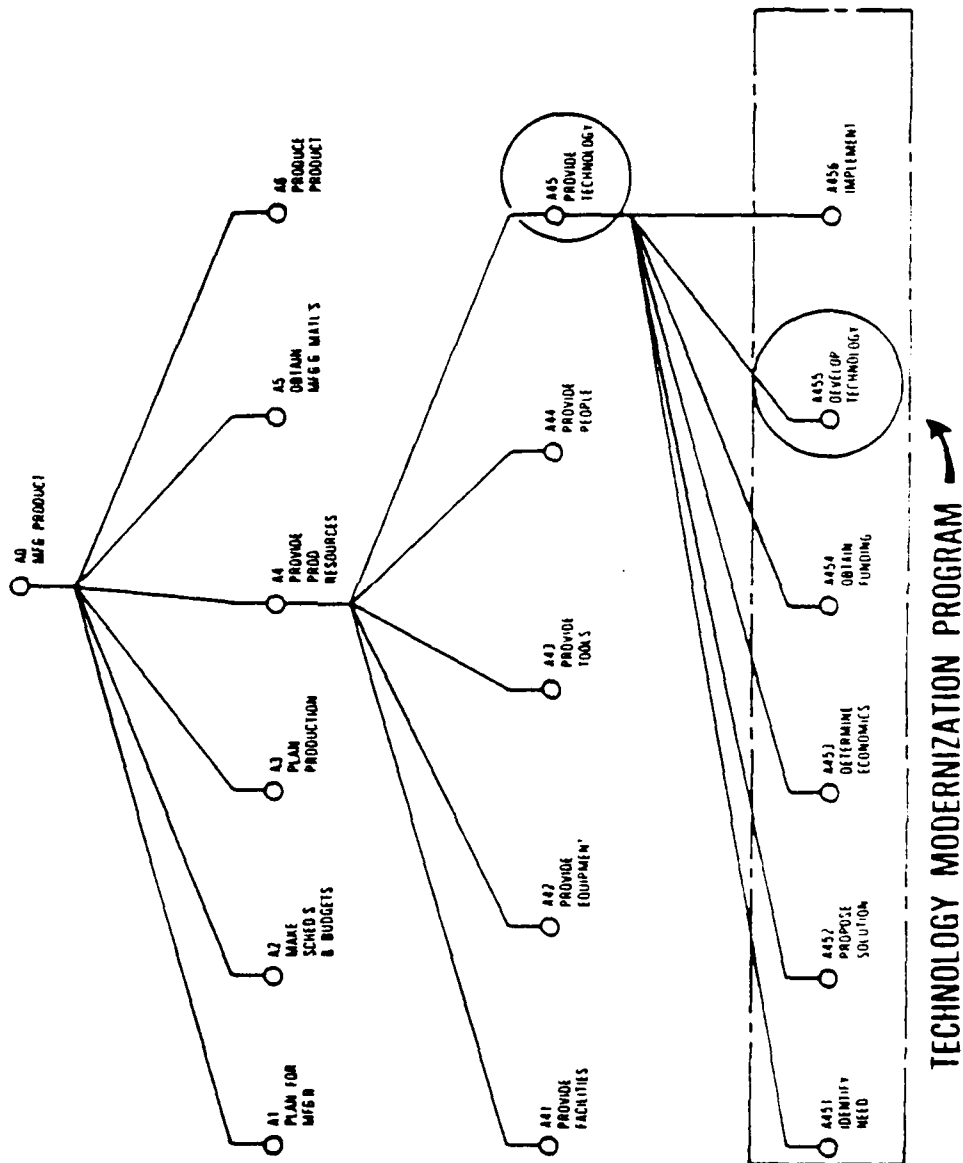
# ORGANIZATIONAL STRUCTURE



# PLANNING VEHICLE

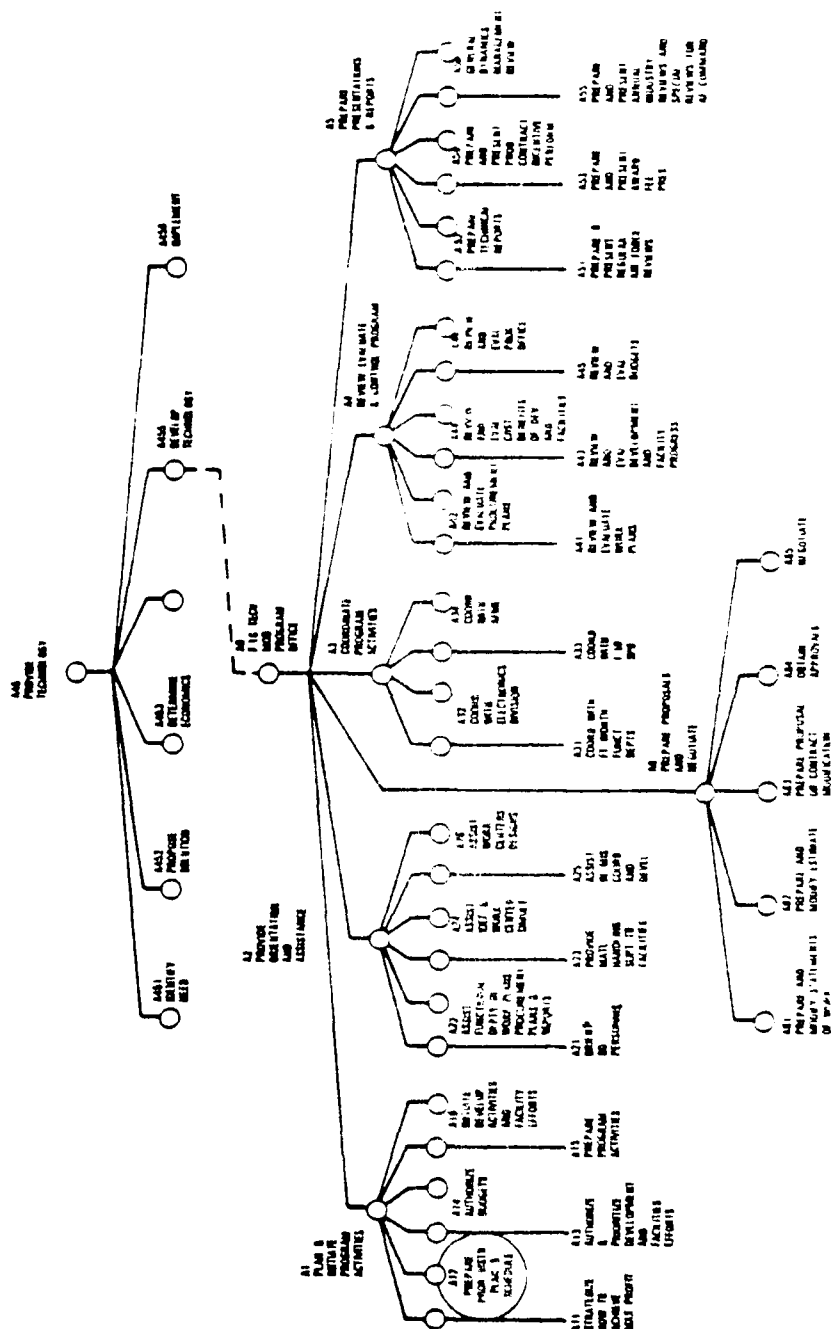


# PROGRAM MANAGEMENT

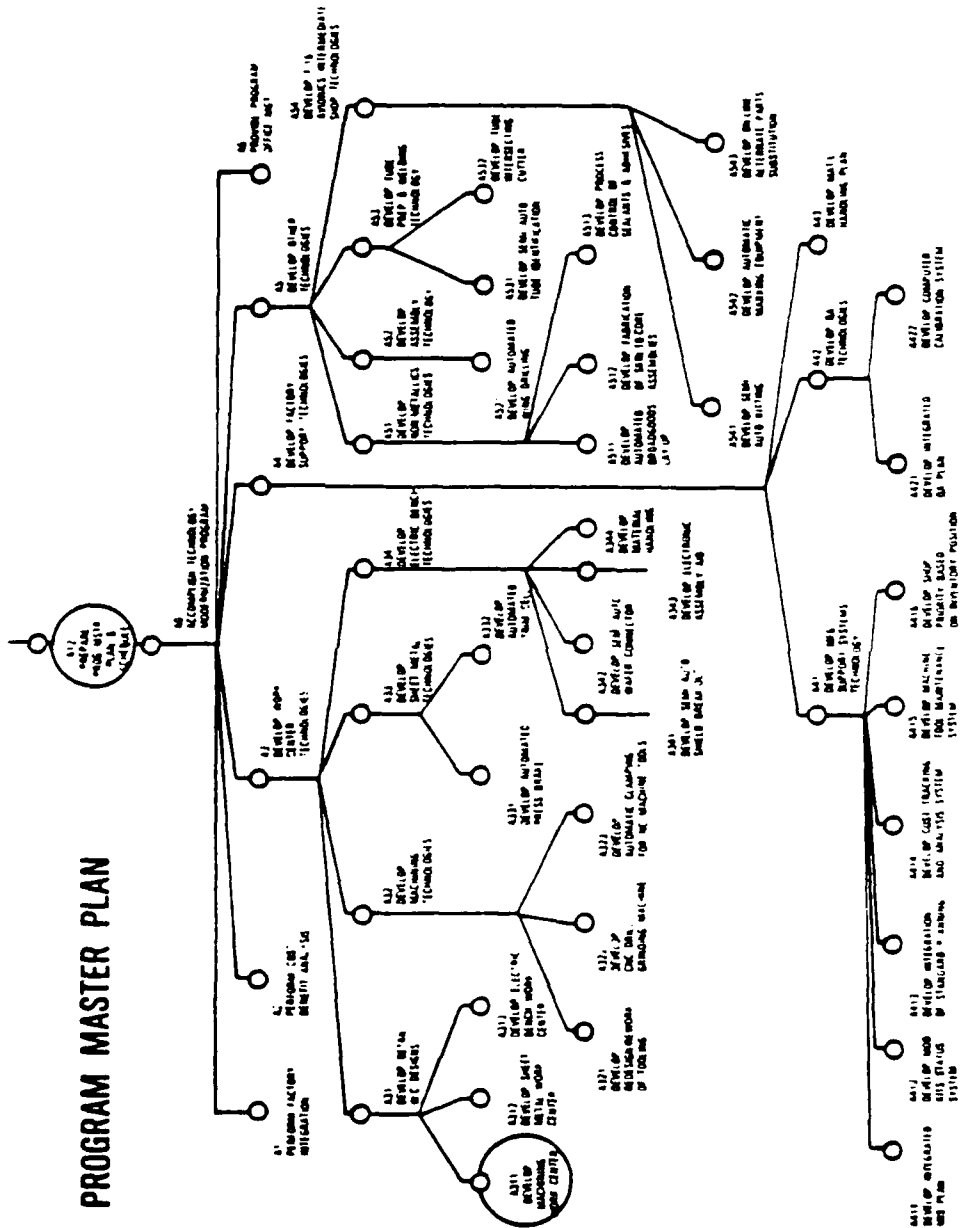


1. *Chlorophyll a* and *Chlorophyll b* contents were determined by the method of Arar and Collins (1987).

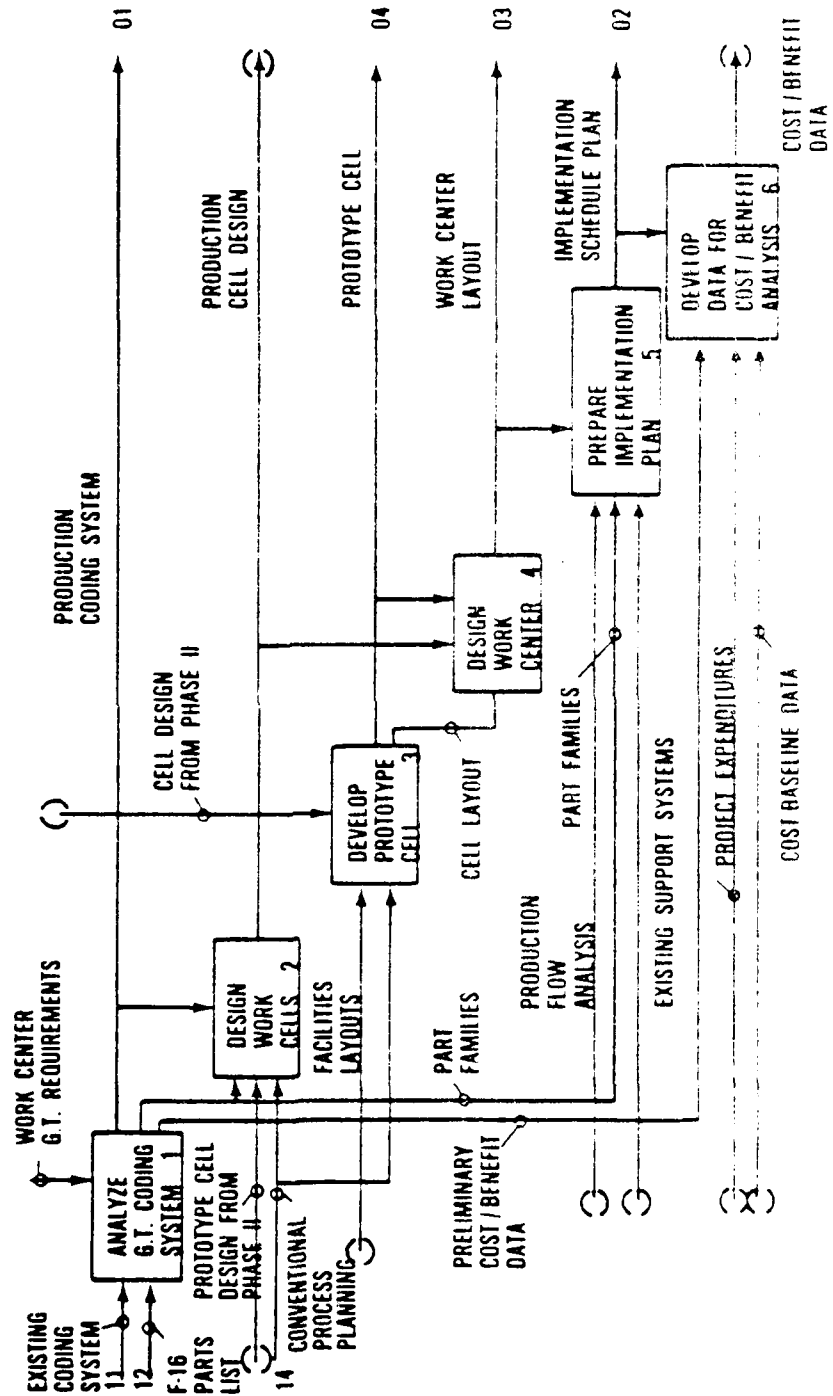
2-334



# PROGRAM MANAGEMENT



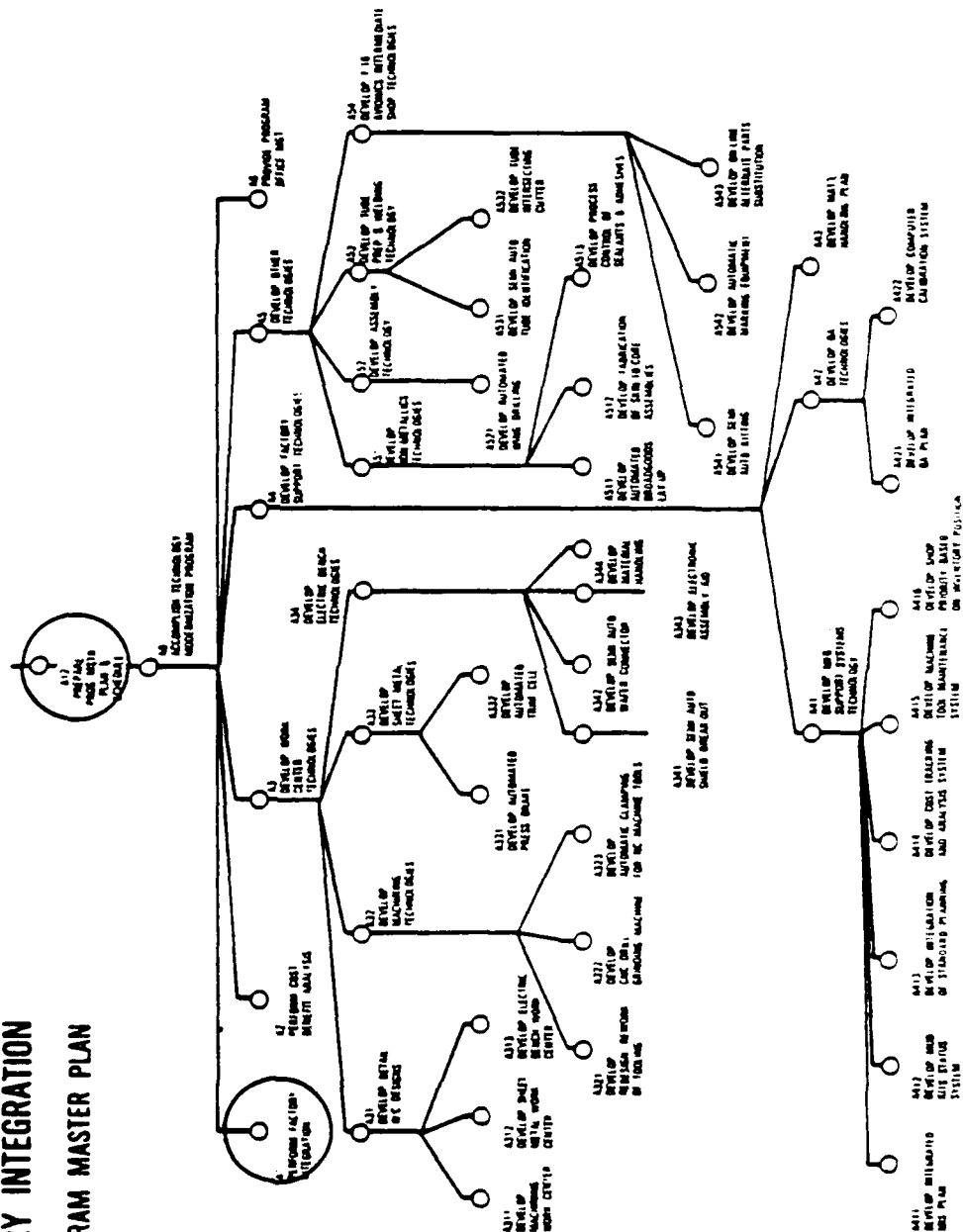
# PROGRAM MANAGEMENT



"TECHNICAL APPROACH"

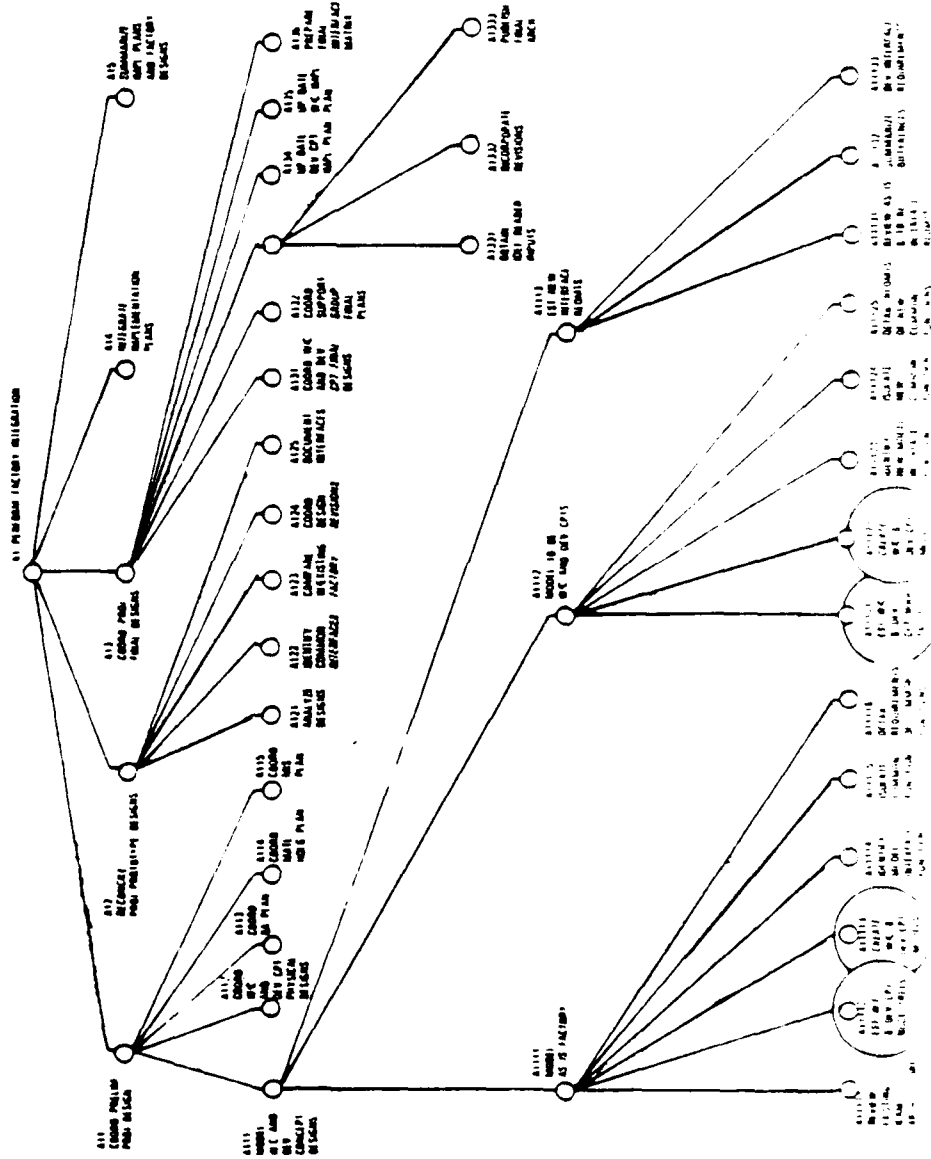
1744  
3 September 1744

2-337



# PROGRAM MANAGEMENT

## PLAN FOR FACTORY INTEGRATION





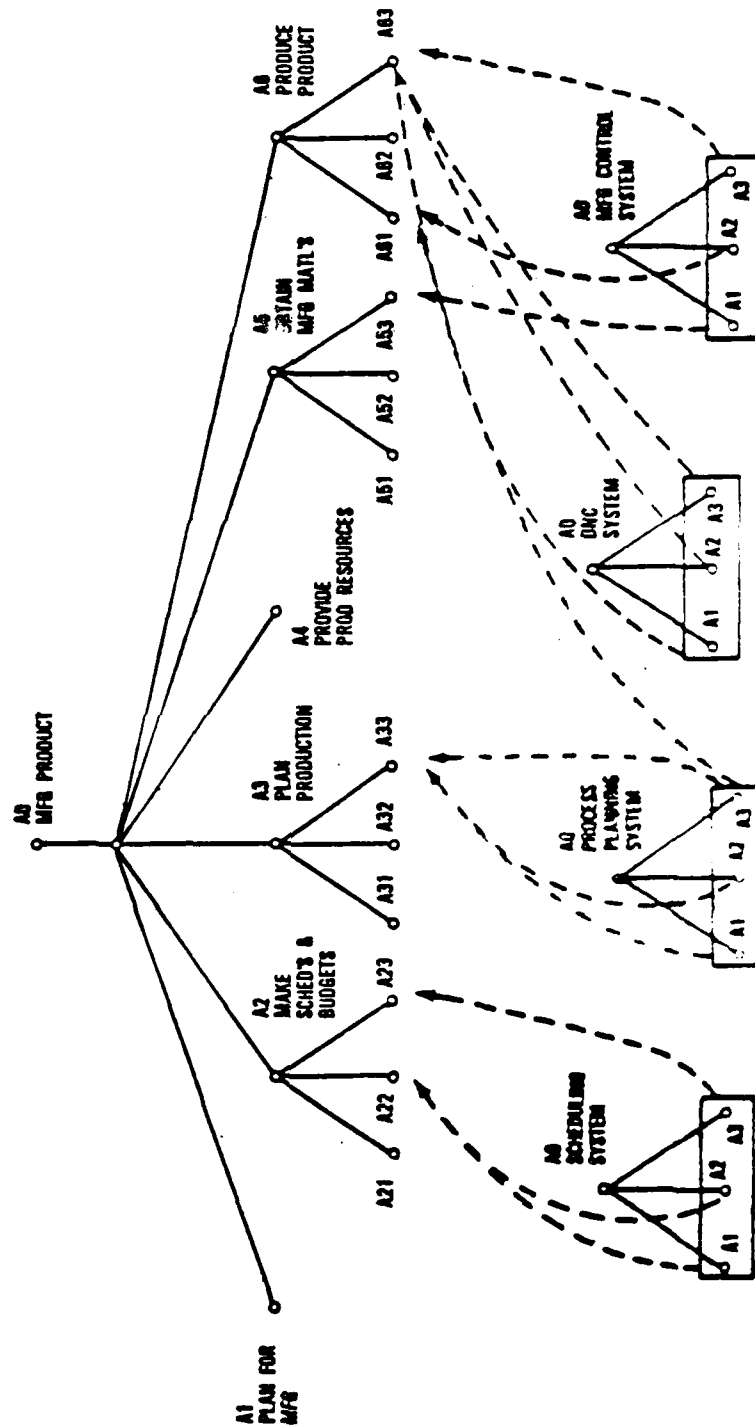
## TECHNICAL TOOL

---

- SYSTEM(S) / TECHNOLOGY(S) STRUCTURE AND INTERFACES
- SYSTEM(S) / TECHNOLOGY(S) — ORGANIZATION(S)  
INTERACTIONS
- SYSTEM(S) / TECHNOLOGY(S) DEVELOPMENT AND  
INTEGRATION

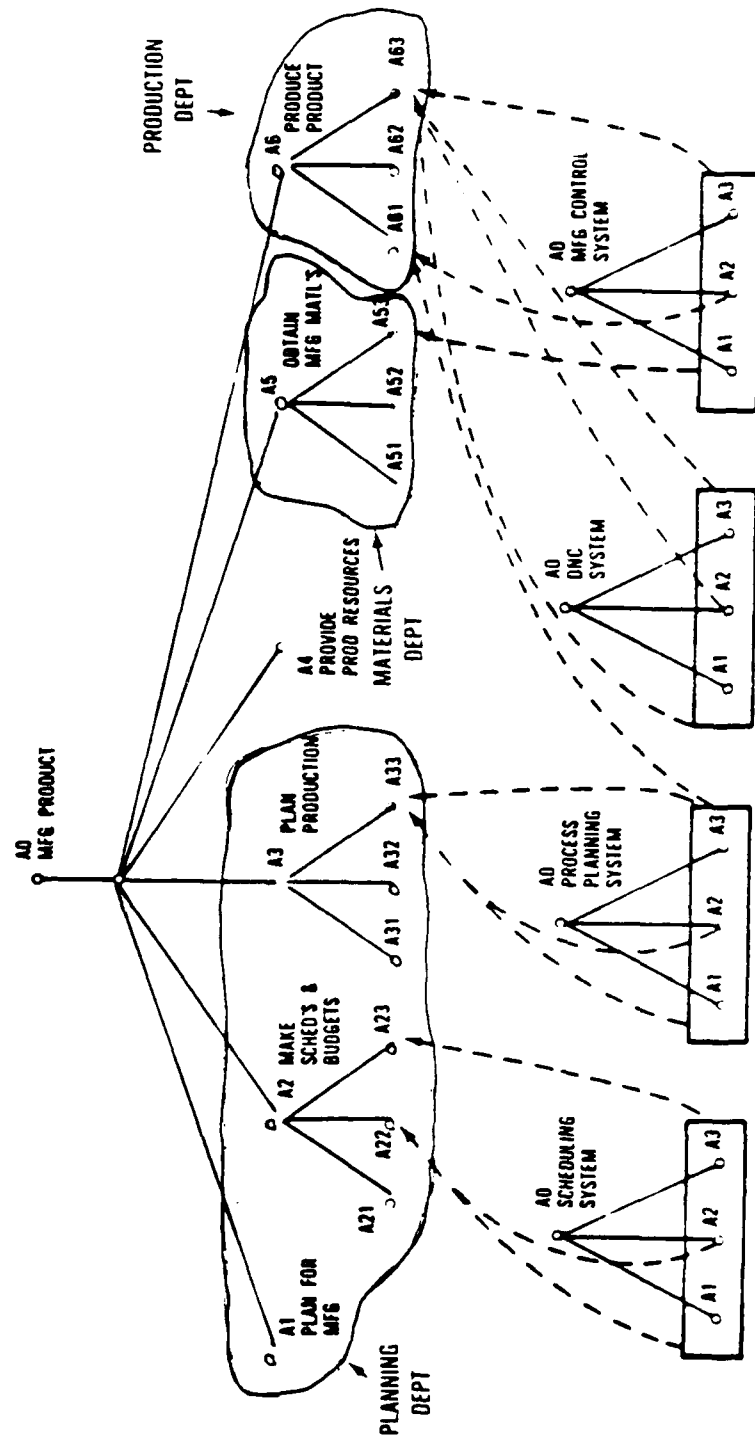
8/11/63  
9 September 1963

# SYSTEM(S) / TECHNOLOGY(S) STRUCTURE AND INTERFACES

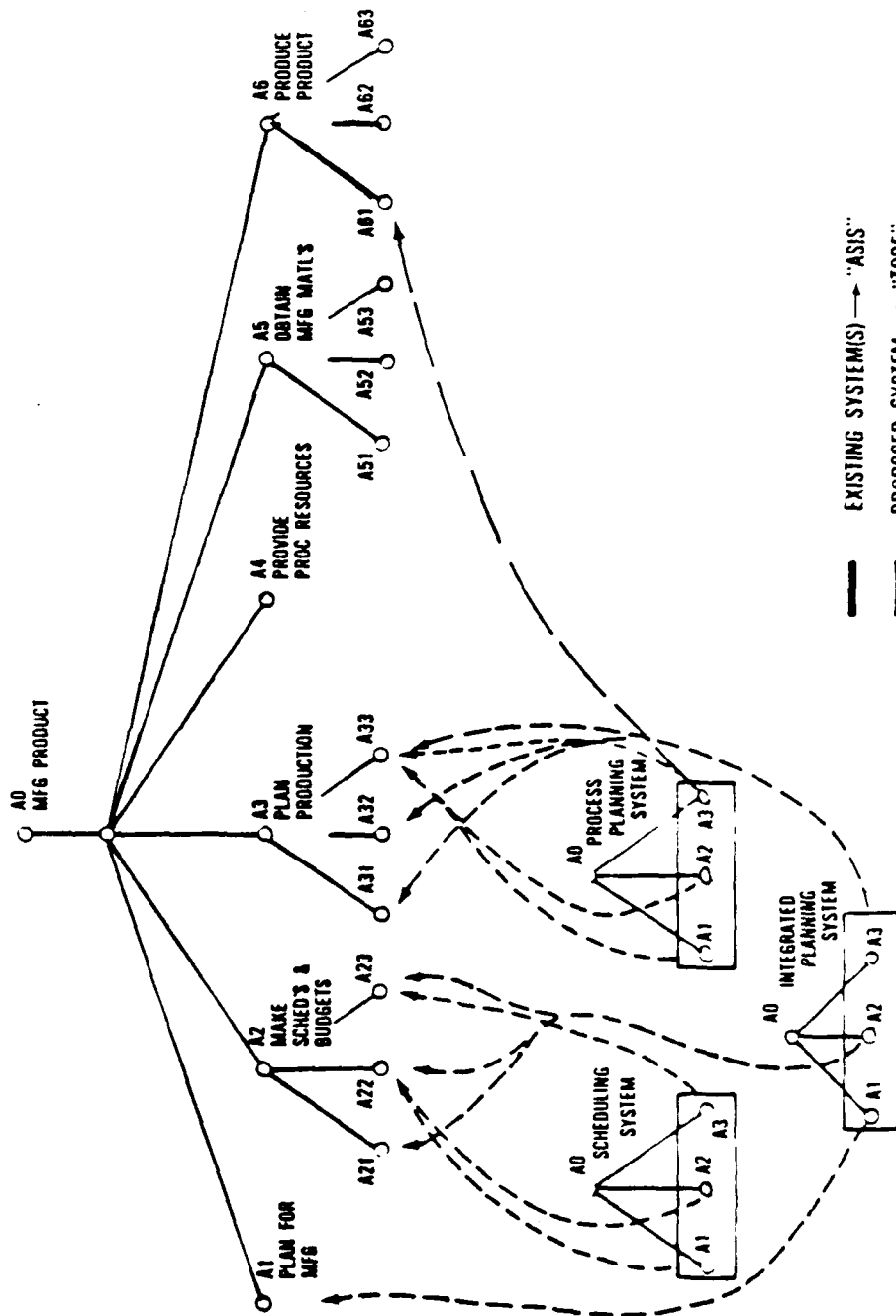


FTP110410-000  
8 SEPTEMBER 1963

# SYSTEM(S) / TECHNOLOGY(S) — ORGANIZATIONS INTERFACES

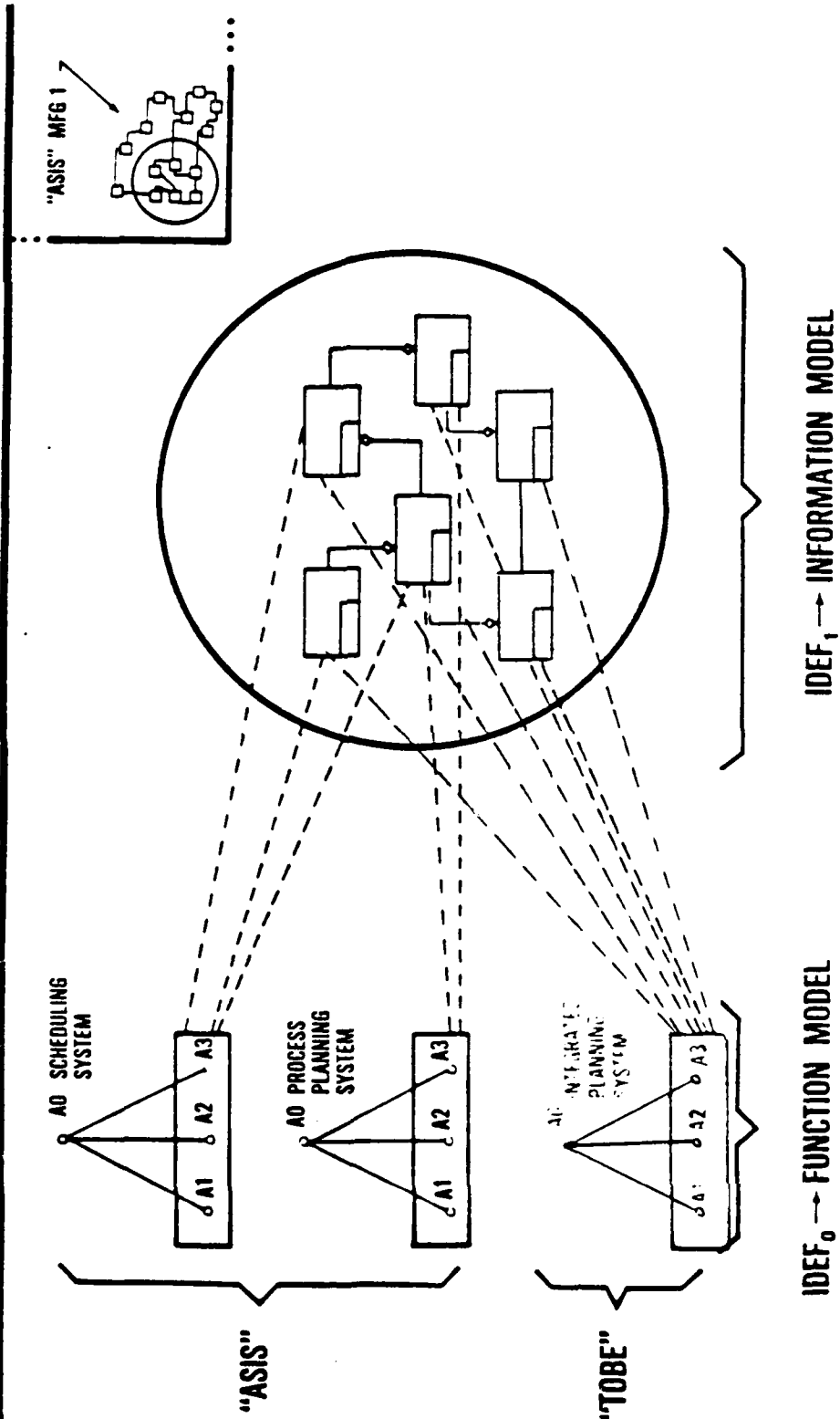


# SYSTEM(S) / TECHNOLOGY(S) DEVELOPMENT AND INTEGRATION



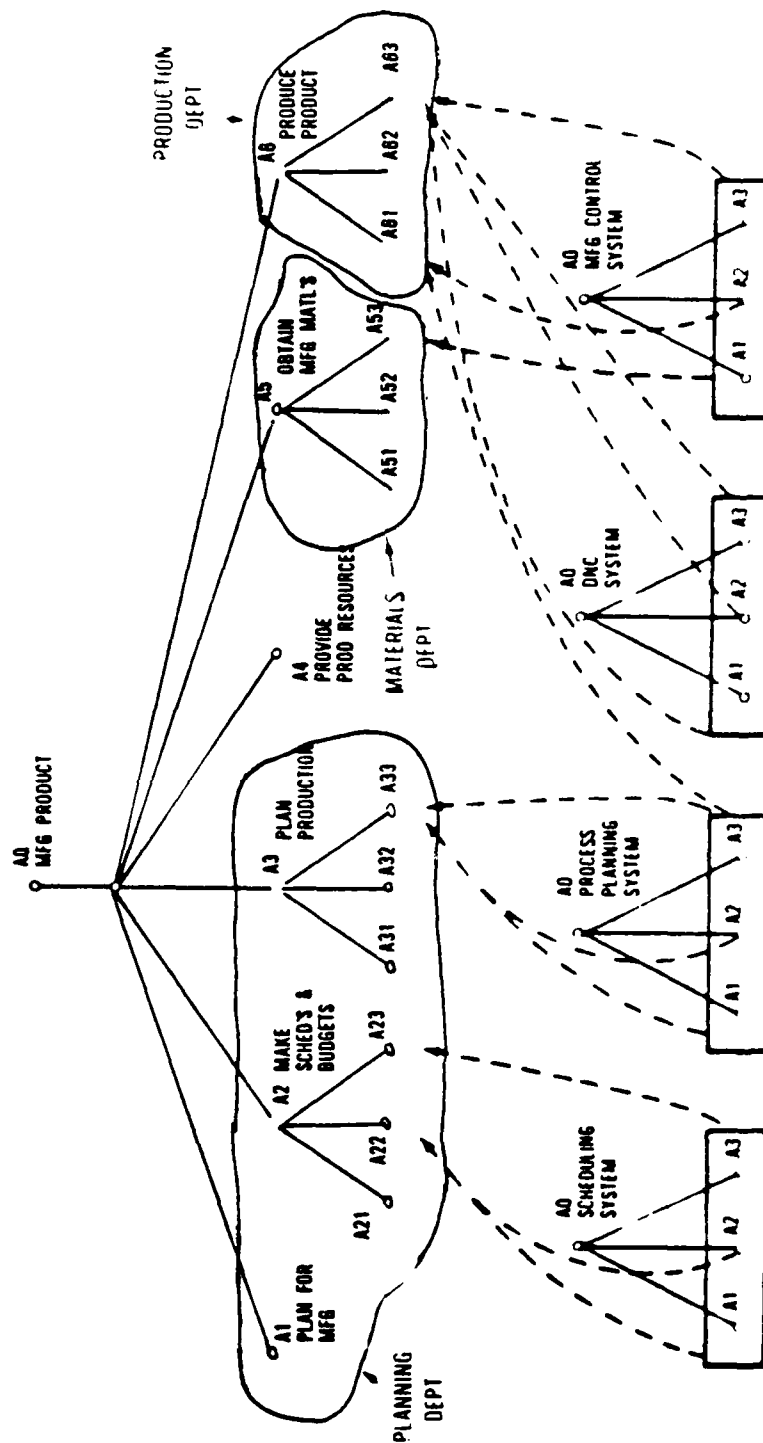
FTR 224-200-10  
 8 September 1977

# SYSTEM(S) / TECHNOLOGY(S) DEVELOPMENT AND INTEGRATION



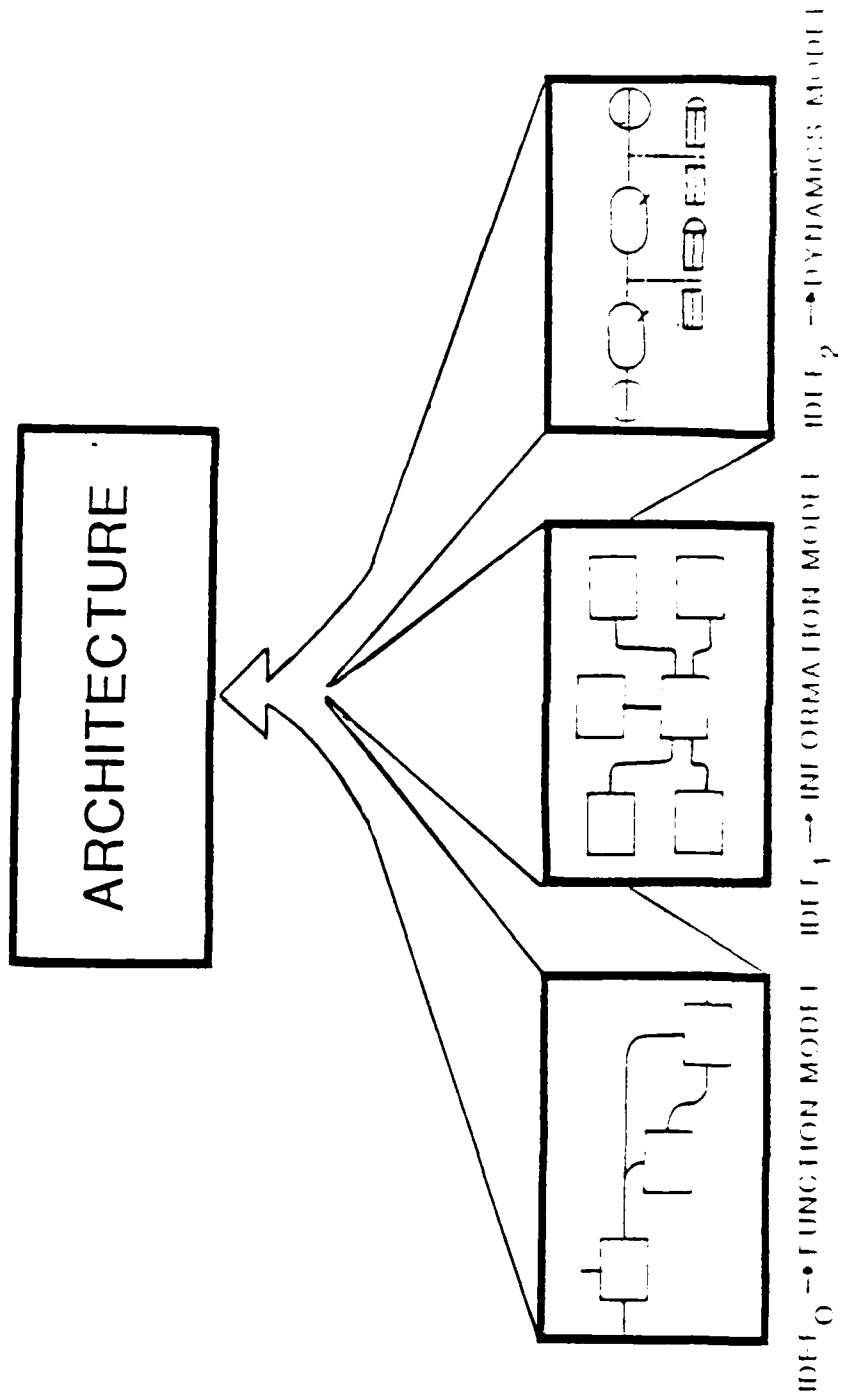
FTAL104100001  
6 September 1983

# EDUCATIONAL TOOL



FTR1104100000  
8 September 1983

# ARCHITECTURE



## 2.4 Technology Transfer Practitioner's "Train the Trainers" Manual

### FOREWORD

This Training Manual is designed to help teach an overview of the U.S. Air Force's Manufacturing TECHNOLOGY MODernization (TECH MOD) Program's use of related IDEF applications, concepts, and procedures. It also covers the use of the resulting Architecture in planning and controlling these Manufacturing Technology Modernization Programs to upgrade the U.S. industrial base.

This training manual is designed to give the instructor maximum efficiency in training manufacturing personnel by employing a step-by-step process, section-by-section, dealing with the concepts and procedures of IDEF0 Function Modeling, including reading, authoring, commenting on, and iterating IDEF0 Function Models.

### TRAIN THE TRAINERS

#### 2.4.1 Introduction

This is an instructor's manual intended to aid those teaching an overview of the Air Force Manufacturing Technology Modernization (TECH MOD) Program's use of related ICAM IDEF0 Function Modeling Methodology. As an instructor's manual, it provides the elements and an order of presentation needed in teaching. The developing of style is left to the individual instructor.

This instructor's manual consists of a guide for conducting and presenting a practitioner's-level briefing; a set of overhead transparencies; and a step-by-step text, containing the objectives or procedures to be covered, concepts, and a suggested narration, handout materials and exercises.

The course materials are presented in a standardized format, divided into four sections. Each page is composed of a copy of the foil, the instructional objective that must be covered with that foil, and a suggested narration that may be followed until individual styles can be developed.

It must be made clear from the start that the ICAM Definition Language (IDEF) requires that both functions and data necessary to carry out a process be modeled.

The IDEF0 Function Modeling Methodology concerns itself with the modeling of functions along with the data those functions employ.

The IDEF0 Function Model is composed of diagrams, text, and glossary.



Both authoring and commenting roles and responsibilities of the Function Models are required for full development of each Function Model, because of the iterative nature of the ILEFM methodology. This ILEFM Training Course discusses Authoring Concepts and Procedures as well as Commenting Concepts and Procedures, respectively.

Overall planning for and conducting of actual training sessions is almost as critical to accomplishing participant learning objectives as the course presentation material. Attention must be given to planning for presentation set-up, pre-presentation, presentation, and post-presentation activities.

#### 2.4.1.1 Presentation Set-Up

##### 2.4.1.1.1 Audio/Visual Equipment:

- a) Overhead vue foil projector
- b) 35mm projector (if slides are used)

##### 2.4.1.1.2 Audio/Visual Aids:

- a) Overhead transparencies
- b) 35mm color transparencies (when slides are used)
- c) Training materials (handouts and/or manuals)

##### 2.4.1.1.3 Room Set-up:

Everyone must be in hearing and seeing distance of the presentation.

REMEMBER: The best instructional program is no good if you can't hear and see it!

#### 2.4.1.2 Pre-Presentation

- Review all training materials beforehand and be familiar with them.
- Make sure room, equipment, and materials are all in order and ready to go when you are.

REMEMBER: Prior planning prevents poor performance!

- Set up audio/visual equipment.
- Get audio/visual aids ready for presentation.

- a) Make sure all overhead transparencies are in their order of presentation.
- b) Make sure all 35mm color transparencies (when slides are used) are in their order of presentation and that they are all placed in carousel right-reading, (a slide in backwards or upside down can throw your whole presentation off kilter).
- Handout training materials:
  - a) IDEF0 Function Modeling Manual  
(Vol. IV - AFWAL-TR-81-4023)
  - b) Composite Function Model of "Manufacture Product"  
(MFG0 - Vol. VII - AFWAL-TR-81-4023)
  - c) MFG0 Node Tree
  - d) DES0 Node Tree
  - e) IDEF Kit Cover Sheet
  - f) IDEF Forms
  - g) IDEF Templates
  - h) Copies of Presentation Materials  
(Handed out section by section as applicable)

#### 2.4.1.3 Presentation

- Give introduction
  - a) Include purpose and viewpoint of presentation.
  - b) Set atmosphere conducive to learning.
- Go through training materials step-by-step.
- Use peer cross-referencing method to check for understanding.

##### PEER CROSS-REFERENCING METHOD

- a) Ask who understands the point you've just presented.
- b) Ask who isn't clear about it.
- c) Ask if anyone who understands the point can explain it to those who don't.

NOTE: If you don't get any takers, you must explain it over again, if possible, in different terms.

- REMEMBER:

Just because you've presented the material doesn't mean that everyone has understood it.

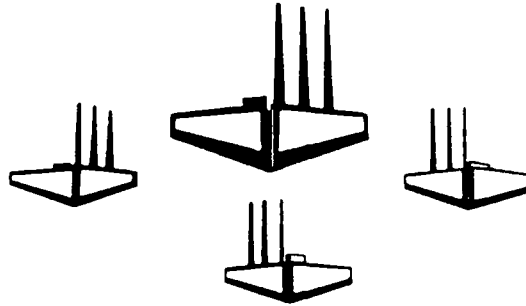
#### 2.4.1.4 Post Presentation

- Try not to leave any question unanswered. If you don't know, find out, and write or call with the answer.
- At some time, a sheet could be filled out with the name, organization, department, phone number, etc. of those attending. Get sheet typed and make copies to give to everyone. Use for:
  - historical record
  - contact sheet.

#### 2.4.2 ICAM IDEF/Architecture

## ICAM

### IDEF ↔ ARCHITECTURE



50-1-1

TITLE SLIDE: ICAM IDEF/Architecture

COURSE OBJECTIVE: Orient and educate the executive level and upper mid-management personnel relative to the U.S. Air Force's Manufacturing Technology Modernization Program and the U.S. Air Force's ICAM planning and analytical tools.

NARRATION: "THE OBJECTIVE OF THIS PRESENTATION IS TO INTRODUCE ICAM DEFINITION METHODOLOGY (IDEF) AND THE UTILIZATION OF THE RESULTING ARCHITECTURE TO IMPROVE MANUFACTURING PRODUCTIVITY. WE WANT TO PROVIDE YOU WITH A BASIC UNDERSTANDING OF THE CONCEPTS AND TOOLS TO BE USED IN PUTTING TOGETHER AND MANAGING A MANUFACTURING TECHNOLOGY MODERNIZATION PROGRAM.

"APPLICATIONS OF THE MANUFACTURING TECHNOLOGY MODERNIZATION CONCEPT INCLUDE:

1. ANALYZING AND IMPROVING CURRENT PLANNING AND MANUFACTURING ACTIVITIES
2. PUTTING TOGETHER AND CARRYING OUT MANUFACTURING TECHNOLOGY MODERNIZATION PROPOSALS
3. MANAGING PROGRAMS USING ICAM TOOLS"

## **IDEF -- ARCHITECTURE**

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- **WHAT IS ICAM ?**
- **WHAT IS IDEF ?**
- **HOW DOES IDEF RELATE  
TO ARCHITECTURE ?**

50-1 2

INSTRUCTIONAL OBJECTIVE: To provide an understanding of  
ICAM/IDEF Architecture.

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NARRATION: "THIS SEGMENT OF OUR MANUFACTURING TECHNOLOGY  
MODERNIZATION PROGRAM ADDRESSES THESE QUESTIONS:

WHAT IS ICAM?

WHAT IS IDEF?

HOW DOES IDEF RELATE TO ARCHITECTURE?"

## WHAT IS ICAM?

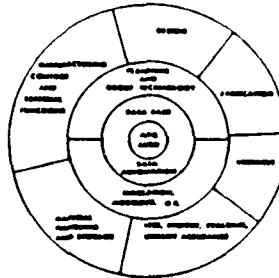
59-1 3

INSTRUCTIONAL OBJECTIVE: To provide an introductory break to the subject of ICAM.

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NARRATION: "WHAT IS INTEGRATED COMPUTER AIDED MANUFACTURING? (ICAM) ICAM IS A USAF THRUST USED TO COMBINE THE POTENTIAL OF THE COMPUTER, INNOVATIVE MANUFACTURING, AND NEW MANAGEMENT CONCEPTS TO IMPROVE PRODUCTIVITY, ON ALL LEVELS, IN AMERICAN INDUSTRY."

ICAM  
INTEGRATED  
COMPUTER-AIDED MANUFACTURING



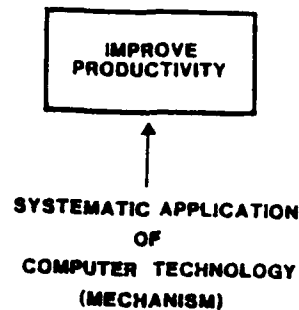
INSTRUCTIONAL OBJECTIVE: To provide an understanding of the importance placed upon the manufacturing architecture developed using the IDEF methodologies.

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NARRATION: "THIS USAF ICAM LOGO ILLUSTRATES THE IMPORTANCE PLACED UPON THE MANUFACTURING ARCHITECTURE DEVELOPED BY THE IDEF METHODOLOGIES - IT IS THE CENTER PIECE OF THE PROGRAM - THE BASIS FOR DEVELOPING INTEGRATED DATABASES AND DATA AUTOMATION.

"THE ICAM LOGO GRAPHICALLY REPRESENTS THE DISCIPLINES OF MANUFACTURING THAT MUST BE RECOGNIZED AS INTEGRAL PARTS OF MANUFACTURING. THE CONCENTRIC PATTERN CAPTURES THE TRANSITION FROM THE INNER CIRCLE THRUST AREAS OF CONCEPT THROUGH TO THE SHOP FLOOR AND FINALLY TO THE PRODUCTION LINE FUNCTIONS AT THE OUTER CIRCLE AREAS."

## PURPOSE OF ICAM



59-1 5

INSTRUCTIONAL OBJECTIVE: To provide an understanding of ICAM's purpose.

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NARRATION: "THEREFORE - THE OVERALL PURPOSE OF ICAM IS TO IMPROVE MANUFACTURING PRODUCTIVITY THROUGH SYSTEMATIC APPLICATION OF COMPUTER TECHNOLOGY. THE ICAM ARCHITECTURE OR FRAMEWORK THAT WE WILL BE DISCUSSING IS PREDICATED ON THIS 'SYSTEMATIC APPLICATION OF COMPUTER TECHNOLOGY.'

"TO IMPROVE PRODUCTIVITY THROUGH THE DEVELOPMENT AND IMPLEMENTATION OF NEW TECHNOLOGY, WE MUST SYSTEMATICALLY 'PLAN - ORGANIZE - CONTROL AND COORDINATE' DATA. HERE WE DEFINE ICAM'S FUNCTION AS IMPROVE PRODUCTIVITY. THE MECHANISM TO 'MAKE IT HAPPEN' WILL BE THE 'SYSTEMATIC APPLICATION OF COMPUTER TECHNOLOGY'."



## ICAM APPROACH

(CONTROL)

COMMUNICATION AND ANALYSIS



SYSTEMATIC APPLICATION  
OF  
COMPUTER TECHNOLOGY  
(MECHANISM)

89-1 6

INSTRUCTIONAL OBJECTIVE: To provide an understanding of the fact that communication and analysis is the key control to improved productivity.

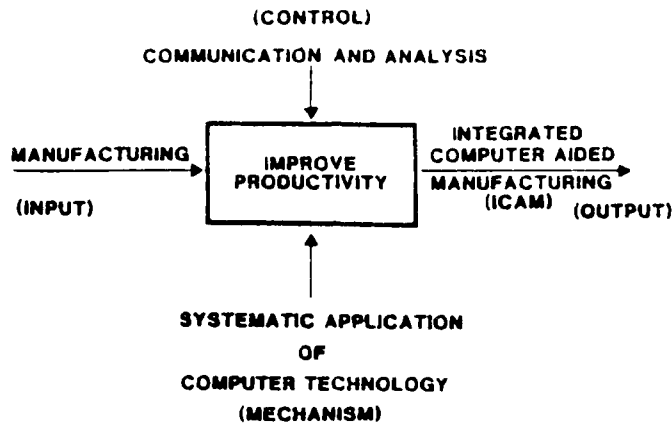
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NARRATION: "THE ICAM APPROACH RECOGNIZES THAT MANUFACTURING IS A VERY COMPLEX ENVIRONMENT COMPRISED OF MANY PEOPLE, SYSTEMS, AND TECHNOLOGIES.

"WHEN WE REFER TO 'MANUFACTURING' WE ARE RELATING TO THE 'TOTAL MANUFACTURING ENTERPRISE', INCLUDING MANAGEMENT'S 'TOP-DOWN' REQUIREMENTS AS WELL AS 'BOTTOM-UP' REQUIREMENTS OF THE FACTORY FLOOR.

"TO IMPROVE PRODUCTIVITY, A COMMON UNDERSTANDING OF THE PROBLEM (EXISTING MANUFACTURING) AND A SOLUTION (FUTURE MANUFACTURING) IS NECESSARY. THIS COMMON UNDERSTANDING MUST BE COMMUNICATED TO AND ANALYZED BY MANY DIFFERENT PEOPLE RANGING FROM THE SHOP FLOOR USER TO THE MANUFACTURING ANALYST, TO THE SYSTEM DEVELOPER, AND FINALLY ON TO MANAGEMENT."

## OBJECTIVE OF ICAM



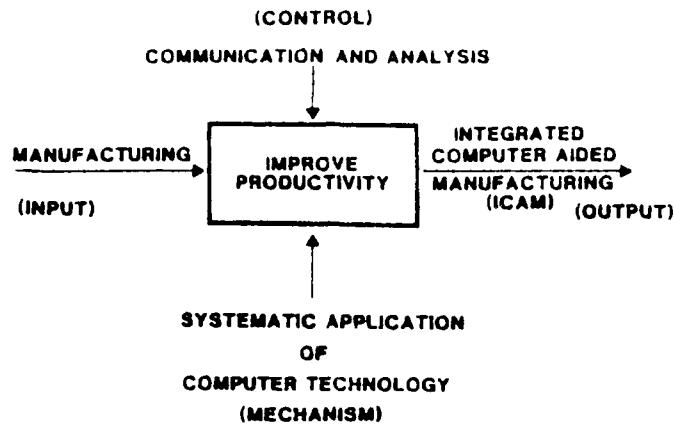
INSTRUCTIONAL OBJECTIVE: To provide an understanding that by utilizing manufacturing as an input, we will accomplish the function of improved productivity and output Integrated Computer Aided Manufacturing (ICAM).

NARRATION: "TO SUMMARIZE - THE ICAM OBJECTIVE IS:

- o FUNCTION - IMPROVE PRODUCTIVITY
- o INPUT - EXISTING MANUFACTURING
- o CONTROL - COMMUNICATION AND ANALYSIS
- o MECHANISM - SYSTEMATIC APPLICATION OF COMPUTER TECHNOLOGY
- o OUTPUT - INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM).

ICAM RECOGNIZES THAT PRODUCTIVITY CAN BE IMPROVED NOT JUST THROUGH THE IMPLEMENTATION OF NEW MANUFACTURING TECHNOLOGY, BUT ALSO THROUGH THE SUCCESSFUL INTEGRATION OF THAT TECHNOLOGY INTO EXISTING MANUFACTURING."

## OBJECTIVE OF ICAM



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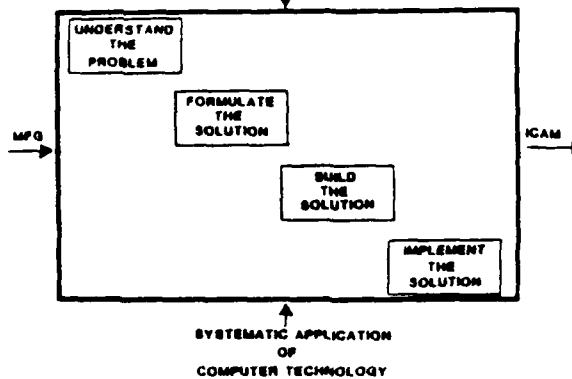
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## IMPROVE PRODUCTIVITY

### COMMUNICATION AND ANALYSIS



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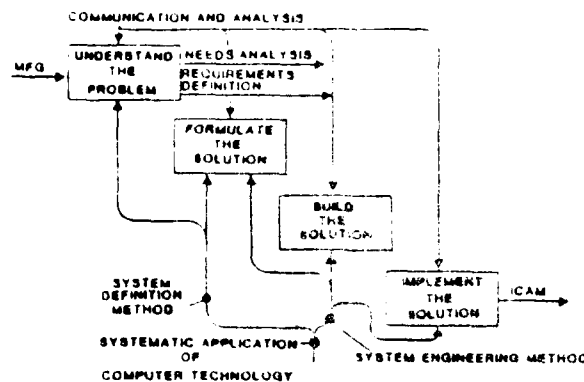
INSTRUCTIONAL OBJECTIVE: To provide an understanding of the IDEF<sub>0</sub> decomposition process and the ICAM life cycle.

NARRATION: "LET'S NOW TAKE AN IDEF<sub>0</sub> FUNCTION ANALYSIS APPROACH AND FURTHER DECOMPOSE (OR BREAKDOWN) THE ICAM LIFE CYCLE MODEL CONTEXT WE JUST DEFINED AND DISCUSSED.

"HERE THE ICAM APPROACH BEGINS TO TAKE SHAPE. ICAM HAS ESTABLISHED A 'SYSTEM DEVELOPMENT LIFE CYCLE' TO CONTROL ITS PROGRAM - UNDERSTAND THE PROBLEM, FORMULATE THE SOLUTION, BUILD THE SOLUTION, AND IMPLEMENT THE SOLUTION.

"EACH IS A FUNDAMENTAL 'COMMUNICATION AND ANALYSIS' ACTIVITY INVOLVED IN THE TRANSITION OF EXISTING MANUFACTURING TO THE FUTURE ICAM."

## IMPROVE PRODUCTIVITY



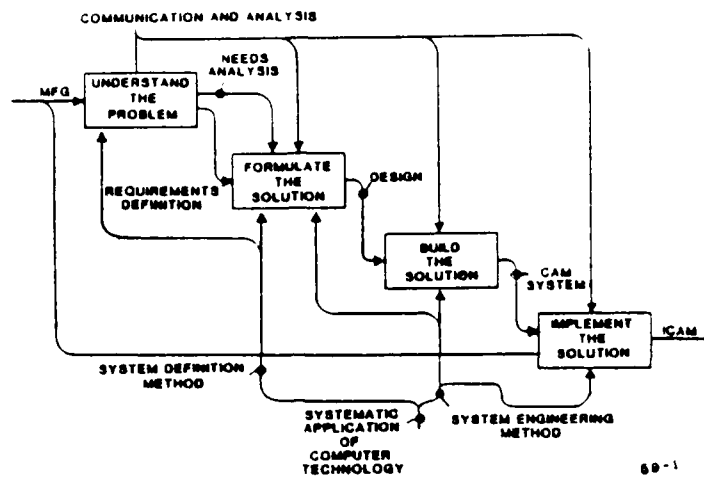
INSTRUCTINAL OBJECTIVE: To provide an understanding of the IDEF0 decomposition process and the ICAM life cycle.

NARRATION: "THE ICAM SYSTEM DEVELOPMENT LIFE CYCLE IS SIMILIAR TO OTHER SUCH LIFE CYCLES EXCEPT THAT ICAM RECOGNIZES THAT THE CURRENT ENVIRONMENT MUST BE STUDIED IN DETAIL TO DETERMINE THE NEEDS OF THAT ENVIRONMENT TO PERMIT AN IN-DEPTH UNDERSTANDING (I.E. PEOPLE, SYSTEMS, AND TECHNOLOGIES).

THE USE OF A STRUCTURED SYSTEM DEFINITION SUCH AS THE USAF ICAM/IDEF METHODOLOGY WILL FACILITATE BETTER UNDERSTANDING, COMMUNICATION, AND ANALYSIS OF THE PROBLEM. BY EMPHASIZING THE 'UNDERSTANDING OF THE PROBLEM' PHASE, ICAM BELIEVES THAT THE TOTAL COST IN TERMS OF TIME AND MONEY FOR SYSTEM DEVELOPMENT AND IMPLEMENTATION WILL BE REDUCED, RESULTING IN THE SUCCESSFUL INTEGRATION OF NEW TECHNOLOGY INTO EXISTING MANUFACTURING.

(TALK THRU CHART DISCUSSING FUNCTIONS, INPUTS, CONTROLS, OUTPUTS, AND MECHANISMS.)

## IMPROVE PRODUCTIVITY



INSTRUCTIONAL OBJECTIVE: To provide an example of how the use of a structured system definition such as the ICAM/IDEF methodology will facilitate better understanding, communication, and analysis of the problem.

NARRATION: "AS A RESULT OF ANALYZING THE NEEDS AND DEFINING THE REQUIREMENTS, ALTERNATIVE IMPROVEMENTS CAN BE CONSIDERED (NEEDS - INPUT REQUIREMENTS - CONTROL)..

"THE EXISTING ENVIRONMENT IS MATCHED AGAINST THE NEEDS TO IDENTIFY THE IMPROVEMENTS WHICH CAN BE EVALUATED FOR INCLUSION IN THE 'TO BE' FUTURE DESIGN.

"USING A STRUCTURED SYSTEM DEFINITION METHOD LIKE THE IDEF METHODOLOGY FACILITATES BETTER UNDERSTANDING, COMMUNICATION, AND ANALYSIS OF THE SOLUTION. THE DESIGN IS THEN CONSTRUCTED AND INTEGRATED INTO EXISTING MANUFACTURING, RESULTING IN ICAM!

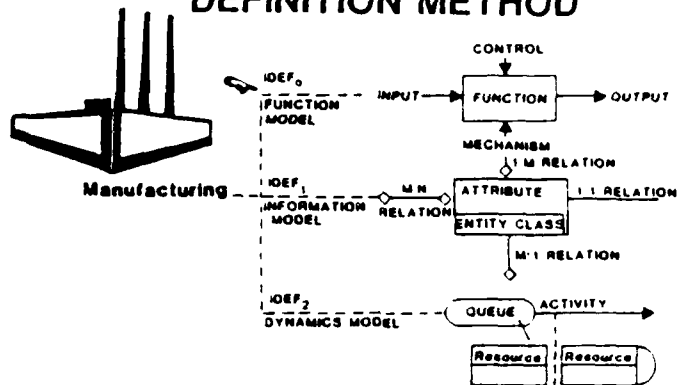
## WHAT IS IDEF?

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INSTRUCTIONAL OBJECTIVE: To provide an understanding of the ICAM Definition (IDEF) method, language or technique.

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NARRATION: "IDEF, THE 'ICAM DEFINITION' METHOD, IS A STRUCTURED APPROACH TO A MODELING METHODOLOGY WHOSE PURPOSE IS TO GRAPHICALLY CAPTURE CHARACTERISTICS OF THE MANUFACTURING FUNCTIONS, INFORMATION SUPPORT FUNCTIONS, AND THE DYNAMICS OF THE FUNCTION AND INFORMATION INTERACTION."

## IDEF - A SYSTEM DEFINITION METHOD



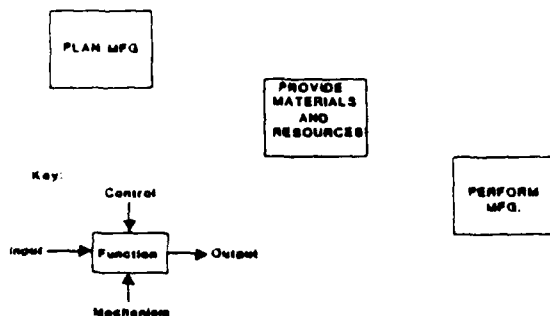
58-1 14

INSTRUCTIONAL OBJECTIVE: To introduce the IDEF<sub>0</sub> function modeling methodology.

NARRATION: "AN IDEF<sub>0</sub> FUNCTION MODEL ANSWERS SPECIFIC QUESTIONS RELATIVE TO THE BASIC FUNCTIONAL BREAKDOWN OR DECOMPOSITION OF THE MANUFACTURING ENTERPRISE."



## IDEF<sub>0</sub> -- FUNCTION MODEL



59-1 18

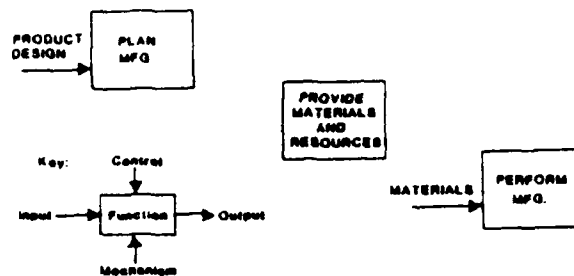
INSTRUCTIONAL OBJECTIVE: To introduce the IDEF<sub>0</sub> function modeling methodology.

NARRATION: "LET'S CONSTRUCT A TOP LEVEL FUNCTION MODEL OF A MANUFACTURING ENTERPRISE'S PRODUCTION ACTIVITY:

- o PLAN MANUFACTURING
- o PROVIDE MATERIAL/RESOURCES
- o PERFORM MANUFACTURING

"PLEASE NOTE THE 'KEY' PROVIDED TO FACILITATE YOUR UNDERSTANDING THROUGH THE NEXT STEPS IN OUR MODEL CONSTRUCTION."

## IDEF<sub>0</sub> -- FUNCTION MODEL

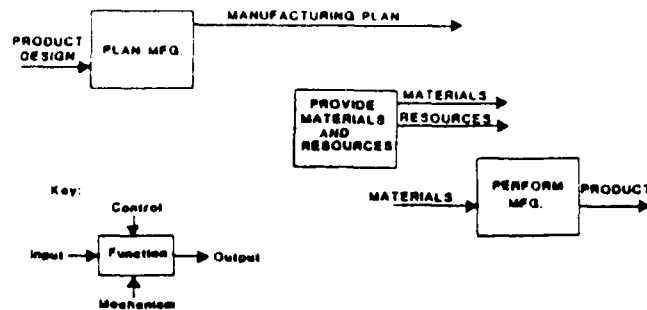


50-1 18

INSTRUCTIONAL OBJECTIVE: To introduce the IDEF<sub>0</sub> function modeling methodology.

NARRATION: "WHAT IS BEING TRANSFORMED AND WHAT IS THE RESULT? HERE WE INPUT 'PRODUCT DESIGN' INTO THE FUNCTION OF 'PLAN MANUFACTURING'."

## IDEF<sub>0</sub> → FUNCTION MODEL



59-1 17

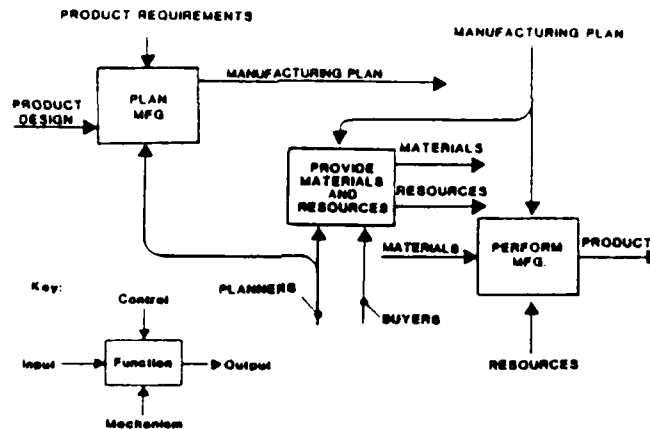
INSTRUCTIONAL OBJECTIVE: To introduce the IDEF<sub>0</sub> function modeling methodology.

NARRATION: "OUR PRODUCT DESIGN 'INPUT' IS BEING TRANSFORMED INTO A MANUFACTURING PLAN AND EVENTUALLY INTO A PRODUCT 'OUTPUT'.

"THE 'OUTPUT' OF THE FUNCTION 'PROVIDE MATERIALS AND RESOURCES' IS 'MATERIALS AND RESOURCES'.

"IN ORDER TO ACCOMPLISH OUR 'PERFORM MANUFACTURING' FUNCTION, WE MUST 'INPUT' MATERIALS."

## IDEF<sub>0</sub> → FUNCTION MODEL



59-1 18

INSTRUCTIONAL OBJECTIVE: To introduce the IDEF<sub>0</sub> function modeling methodology.

NARRATION: "WHAT INFLUENCES THESE FUNCTIONS?"

'PLAN MANUFACTURING' IS INFLUENCED BY 'PRODUCT REQUIREMENTS'.

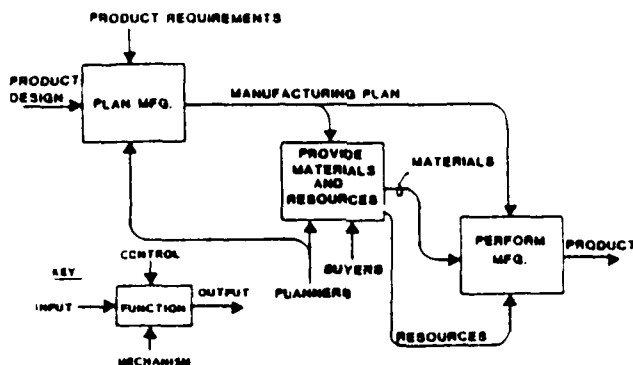
'PROVIDE MATERIALS AND RESOURCES' AND 'PERFORM MANUFACTURING' ARE INFLUENCED BY THE 'MANUFACTURING PLAN'.

WHAT IS NECESSARY TO CARRY OUT THESE FUNCTIONS?

'PERFORM MANUFACTURING' REQUIRES THE MECHANISM OF 'RESOURCES' SUCH AS EQUIPMENT, TOOLS, AND PEOPLE.

THE OTHER FUNCTIONS REQUIRE PEOPLE - PLANNERS AND BUYERS."

## IDEF<sub>0</sub> → FUNCTION MODEL



58-1 18

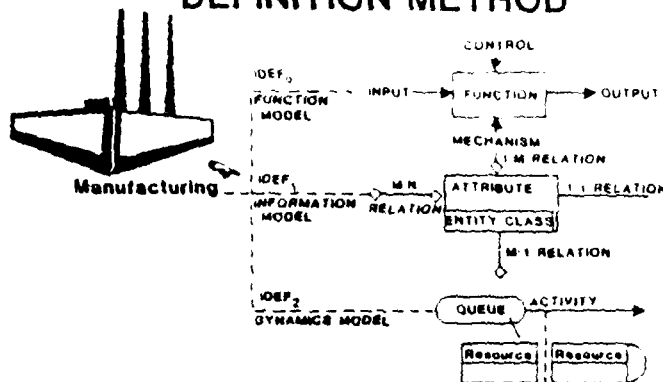
INSTRUCTIONAL OBJECTIVE: To introduce the IDEF<sub>0</sub> function modeling methodology.

NARRATION: "HERE WE HAVE CLEANED UP OUR IDEF<sub>0</sub> MODEL DIAGRAM FOR YOU TO ILLUSTRATE THAT:

IDEF IS USED TO PRODUCE A FUNCTION MODEL PERSPECTIVE, A BLUEPRINT, A STRUCTURED DESCRIPTION OF WHAT IS BEING PERFORMED.

YOU MAY FURTHER DECOMPOSE EACH OF THESE FUNCTIONS TO PROVIDE A BREAKDOWN TO ANY DESIRED LEVEL OF DETAIL, THEREBY PROVIDING A FUNCTIONAL ARCHITECTURE OR FRAMEWORK OF MANUFACTURING."

## IDEF - A SYSTEM DEFINITION METHOD



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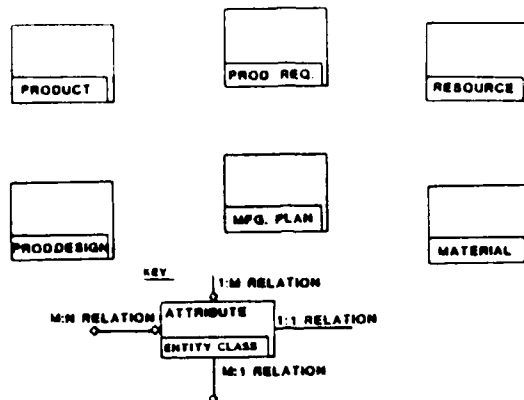
INSTRUCTIONAL OBJECTIVE: To introduce the IDEF<sub>1</sub> information modeling methodology.

NARRATION: "THE IDEF<sub>1</sub> INFORMATION MODEL PROVIDES AN IN-DEPTH DESCRIPTION OF INFORMATION BY FOCUSING ON THE STRUCTURE OF INFORMATION IN SUPPORT OF WHAT IS BEING PERFORMED.

"WE FEEL THAT THIS MODELING PERSPECTIVE IS ABSOLUTELY ESSENTIAL TO THE INTEGRATION OF IDEF<sub>0</sub> FUNCTION MODELS AND THE DEVELOPMENT OF AN INTEGRATED DATABASE.

"THE IDEF<sub>1</sub> INFORMATION MODELS ARE PROVING TO BE ICAM'S KEY SYSTEM INTEGRATION TOOL."

## IDEF<sub>1</sub> -- INFORMATION MODEL



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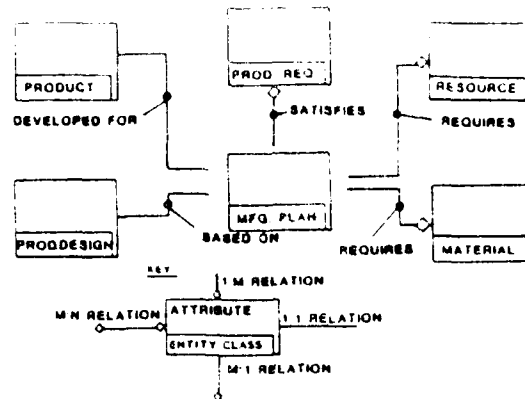
INSTRUCTIONAL OBJECTIVE: To introduce the IDEF<sub>1</sub> information modeling methodology.

NARRATION: "AN IDEF<sub>1</sub> INFORMATION MODEL CAN ANSWER SPECIFIC QUESTIONS REGARDING ANY INFORMATION ELEMENT (ENTITY CLASS) - SOMETIMES THE IDEF<sub>1</sub> MODEL ANSWERS QUESTIONS NOT DEFINABLE IN IDEF<sub>0</sub> FUNCTION MODELS.

"PLEASE AGAIN NOTE THAT WE HAVE PROVIDED A MODEL KEY ON EACH OF THESE PRESENTATIONS TO FACILITATE YOUR UNDERSTANDING. THE IDEF<sub>1</sub> PRIMITIVES ARE ENTITIES, ATTRIBUTES, AND RELATIONS.

"LET'S EXAMINE THE RELATIONS BETWEEN OUR MANUFACTURING PLAN AND THE OTHER ENTITIES SHOWN."

## IDEF<sub>1</sub> → INFORMATION MODEL



50-1 22

INSTRUCTIONAL OBJECTIVE: To introduce the IDEF<sub>1</sub> information modeling methodology.

NARRATION: "WHAT IS THE RELATION OF ALL THE OTHER INFORMATION ELEMENTS SHOWN TO THE 'MANUFACTURING PLAN' ENTITY CLASS?"

EACH 'PRODUCT' HAS A SPECIFIC 'MANUFACTURING PLAN.'

EACH DESIGN HAS A SPECIFIC 'MANUFACTURING PLAN.'

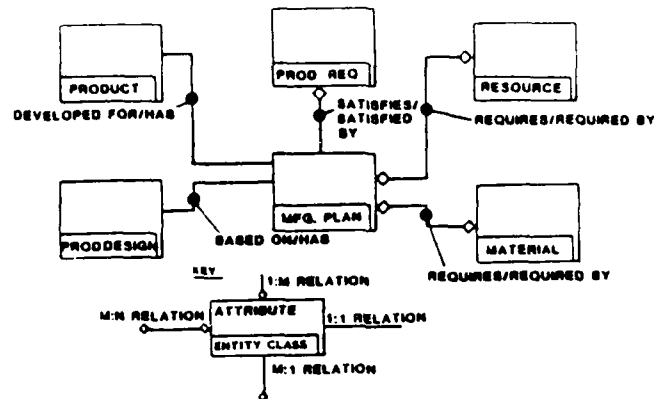
MANY PRODUCT REQUIREMENTS MAY BE SATISFIED BY THE 'MANUFACTURING PLAN.'

MANY 'RESOURCES' ARE REQUIRED BY THE 'MANUFACTURING PLAN.'

MANY 'MATERIALS' ARE REQUIRED BY THE 'MANUFACTURING PLAN.'



## IDEF, -- INFORMATION MODEL



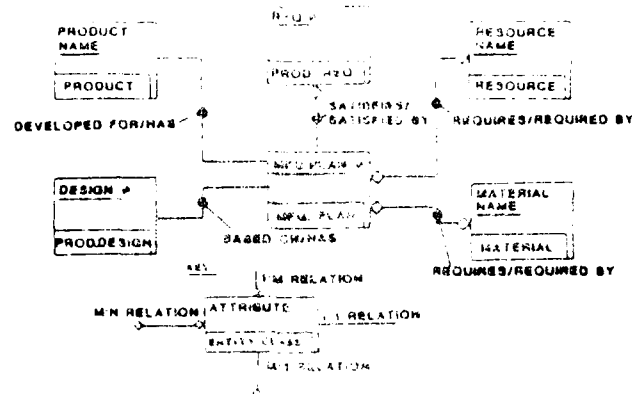
59-1 23

INSTRUCTIONAL OBJECTIVE: To introduce the IDEF<sub>1</sub> information modeling methodology.

NARRATION: "FOLLOWING THE SAME ANALYSIS TECHNIQUE WE HAVE NOW COMPLETED THE RELATION DIAGRAMMING FOR THE RELATION CLASSES SHOWN."

(REVIEW EACH USING 'MANUFACTURING PLAN' AS 'CENTER.')

## IDEF<sub>1</sub> - INFORMATION MODEL



59-1 24

INSTRUCTIONAL OBJECTIVE: To provide an introduction to the IDEF<sub>1</sub> information modeling methodology.

NARRATION: "LET'S EXAMINE SOME OF THE CHARACTERISTICS OR ATTRIBUTE CLASSES OF THESE ENTITY CLASSES WHICH ARE NECESSARY TO BE MAINTAINED."

(REVIEW ATTRIBUTE CLASSES.)

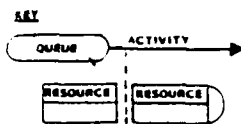
"IDEF<sub>1</sub> IS USED TO PRODUCE AN INFORMATION MODEL PERSPECTIVE, A 'DATA DICTIONARY', AND A STRUCTURED DESCRIPTION OF THE BASIC INFORMATION ELEMENTS."

"THE MODEL DEFINES, CROSS-REFERENCES, RELATES, AND CHARACTERIZES INFORMATION TO THE LEVEL OF DETAIL NECESSARY TO SUPPORT AND INTEGRATE THE MANUFACTURING ENVIRONMENT."

"IDEF<sub>1</sub> MODELS ARE ESSENTIAL TO COMMUNICATE THE INTER-RELATIONSHIP OF INFORMATION AND TO PLAN INTEGRATED COMPUTER AIDED MANUFACTURING."

"IDEF<sub>1</sub> MODELS PROVIDE THE BASIC TO ANALYZE THE COMMON, SHARED, AND PRIVATE INFORMATION NEEDS OF THE MANUFACTURING ENVIRONMENT."

## IDEF<sub>2</sub> -- DYNAMICS MODEL



88-1

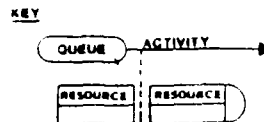
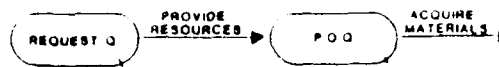
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INSTRUCTIONAL OBJECTIVE: To introduce the IDEF<sub>2</sub> dynamics modeling methodology.

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NARRATION: "THE IDEF<sub>2</sub> DYNAMICS MODEL REPRESENTS THE TIME DEPENDENT CHARACTERISTICS OF MANUFACTURING. IT IS USED TO DESCRIBE AND ANALYZE THE BEHAVIOR OF FUNCTIONS AND INFORMATION INTERACTIONS OVER TIME."

## IDEF<sub>2</sub> ↔ DYNAMICS MODEL



30-1 20

INSTRUCTIONAL OBJECTIVE: To introduce the IDEF<sub>2</sub> dynamics modeling methodology.

NARRATION: "IDEF<sub>2</sub> MODELS ANSWER SPECIFIC QUESTIONS ABOUT ANY OBJECT OR INFORMATION AS IT PASSES THROUGH THE MANUFACTURING ENVIRONMENT.

FOR EXAMPLE:

WHAT ACTIVITIES DOES THE MANUFACTURING PLAN FLOW THROUGH? 'PROVIDE RESOURCES' AND 'ACQUIRE MATERIALS.'"

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INTEGRATED COMPUTER-AIDED MANUFACTURING (ICAM)  
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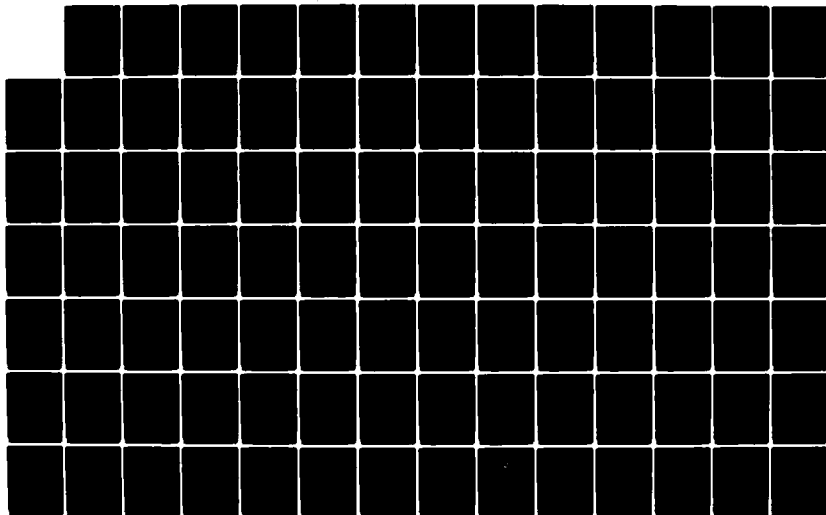
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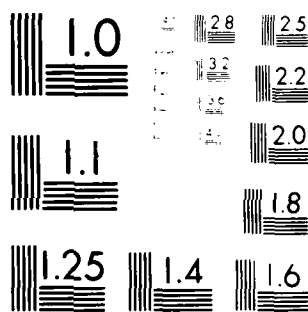
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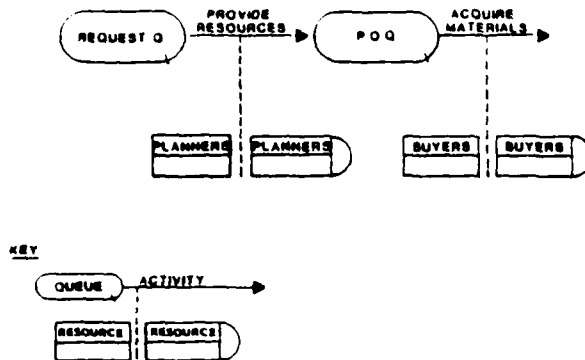
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NA-RES-100-1 RESOLUTION TEST CHART  
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## IDEF<sub>2</sub> -- DYNAMICS MODEL



50-1 27

INSTRUCTIONAL OBJECTIVE: To introduce the IDEF<sub>2</sub> dynamics modeling methodology

NARRATION: "WHAT TIME IS REQUIRED TO ACCOMPLISH THESE ACTIVITIES?"

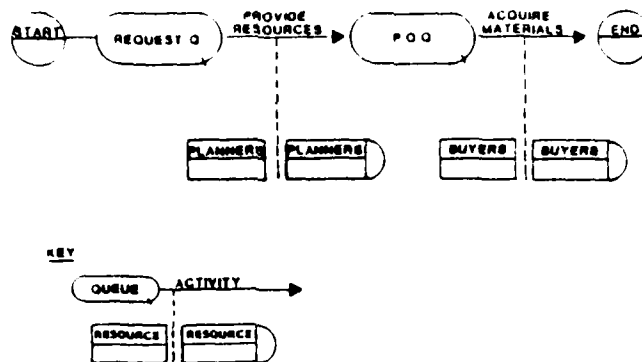
WHAT TIME IS CONSUMED IN QUE WAITING TO BE PROCESSED BY THE ACTIVITIES?

WHAT RESOURCES ARE ALLOCATED, UTILIZED, AND DEAL-LOCATED BY THE ACTIVITIES?

"ONCE THESE QUESTIONS HAVE BEEN ANSWERED, BECAUSE OF TIME RELATIVE INFORMATION ASSOCIATED WITH EACH QUESTION, FURTHER QUESTIONS MAY BE ANSWERED REGARDING PERFORMANCE OF FLOW - SUCH AS:

WHAT IS THE TOTAL PROCESSING TIME OF THE MANUFACTURING PLAN? - WHAT IS THE TOTAL TIME A MANUFACTURING PLAN IS WAITING IN QUE TO BE PROCESSED? - WHAT IS THE UTILIZATION OF RESOURCES AND WHAT STATISTICS ARE ASSOCIATED WITH THESE TIMES.

## IDEF<sub>2</sub> → DYNAMICS MODEL



58-1 28

INSTRUCTIONAL OBJECTIVE: To introduce the IDEF<sub>2</sub> dynamics modeling methodology.

NARRATION: "IDEF<sub>2</sub> THEREFORE IS USED TO PRODUCE A DYNAMICS MODEL, A 'SCENARIO' - A STRUCTURED DESCRIPTION OF THE TIME ORIENTED BEHAVIOR OF FUNCTIONS AND INFORMATION, AND PREVIOUS QUANTITATIVE INFORMATION AS TO THEIR SEQUENCE, DURATION, AND FREQUENCY AT A LEVEL OF DETAIL NECESSARY TO ANALYZE HOW MANUFACTURING IS PERFORMED. (I.E. COMMUNICATE FUNCTION/INFORMATION INTERRELATION - ANALYZE RESOURCE UTILIZATION (THROUGHPUT TIME COSTS))."



## HOW DOES IDEF RELATE TO ARCHITECTURE ?

INSTRUCTIONAL OBJECTIVE: To provide an understanding of the relationship between ICAM IDEF methodology and the resulting manufacturing architecture

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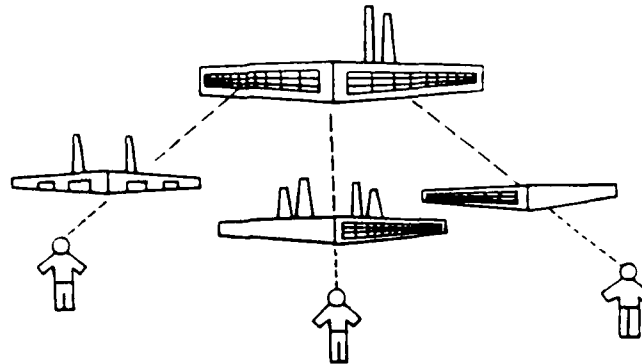
NARRATION: (PASS OUT ARCHITECTURE BOOKS AND NODE TREES.)

"THE HANDOUTS YOU HAVE JUST RECEIVED INCLUDE AN EXTRACT FROM AN ICAM 'ARCHITECTURE OF MANUFACTURING' REPORT. THE GENERIC DIAGRAMS AND RESULTING ARCHITECTURE PROVIDED WERE DEVELOPED BY A COALITION OF AEROSPACE COMPANIES AND OTHER ORGANIZATIONS FOR THE AIR FORCE. THIS PACKAGE IS REFERRED TO AS MFGO. THE CORRESPONDING ICAM DESIGN ARCHITECTURE IS REFERRED TO AS DESO.

"THE MANUFACTURING ARCHITECTURE NODE TREE PROVIDES A PICTORIAL REPRESENTATION OF THE IDEFO DIAGRAMS PROVIDED IN THE HANDOUTS.

"WHENEVER WE REFER TO THE ICAM MANUFACTURING ARCHITECTURE THROUGHOUT THE REST OF THIS PRESENTATION, WE ARE REFERRING TO THESE DOCUMENTS AND ANTICIPATED UPDATING DOCUMENTS TO BE PUBLISHED BY THE AIR FORCE IN THE FUTURE."

## ARCHITECTURE STANDARD FOR COMMUNICATION



89-1 30

INSTRUCTIONAL OBJECTIVE: To provide an understanding of the fact that the generic manufacturing architecture provides a standard for communication.

NARRATION: "THE GENERIC ICAM MANUFACTURING ARCHITECTURE HAS BEEN AND IS BEING DEVELOPED THROUGH COALITIONS OF AEROSPACE CONTRACTORS.

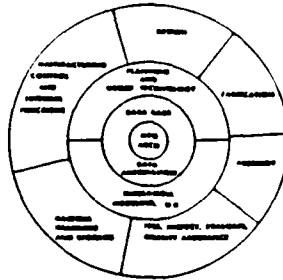
"EACH COALITION PARTICIPANT MODELED HIS OWN 'FACTORY VIEW' OF THE ARCHITECTURE.

"THESE INDIVIDUAL FACTORY VIEWS WERE THEN COMPOSITED INTO THE GENERIC MANUFACTURING ARCHITECTURE.

"WHEN YOU UTILIZE THE GENERIC ARCHITECTURE PLAN AND DEVELOP YOUR MANUFACTURING TECHNOLOGY MODERNIZATION PROGRAM, THE PROCESS IS REVERSED.

"THE GENERIC ARCHITECTURE PROVIDES A STANDARD FOR COMMUNICATION, UNDERSTANDING, AND ANALYSIS."

ICAM  
INTEGRATED  
COMPUTER-AIDED MANUFACTURING



10-1 31

INSTRUCTIONAL OBJECTIVE: To provide a review of the ICAM logo and its pictorial representation of the generic manufacturing architecture.

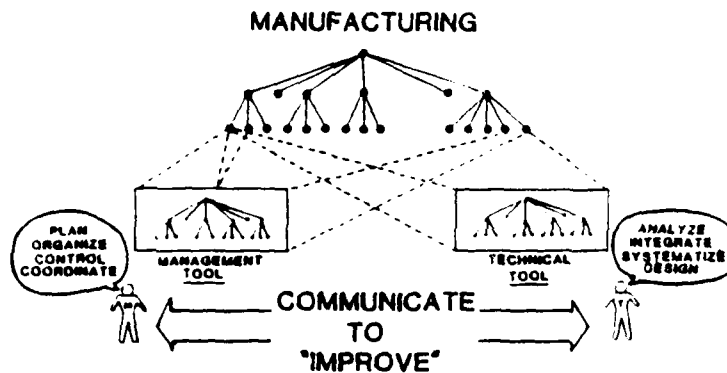
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NARRATION: "THE ICAM LOGO WE REVIEWED EARLIER SHOWS THE ICAM MANUFACTURING GENERIC ARCHITECTURE AS THE CENTER PIECE OF THE ICAM PROGRAM.

"THE IDEF, INFORMATION ARCHITECTURE TARGETS DIRECTLY INTO THE SURROUNDING INTEGRATION RING OF DATA BASE AND DATA AUTOMATION.

"THAT'S ONE OF THE REASONS THE AIR FORCE REQUIRES A MANAGEMENT INFORMATION SYSTEM (MIS) PLAN AS A PART OF THE MANUFACTURING TECHNOLOGY MODERNIZATION PROGRAM."

## ARCHITECTURE



89-1 32

INSTRUCTIONAL OBJECTIVE: To provide an understanding of the fact that the generic manufacturing architecture provides a communication tool between management and technical personnel at all levels.

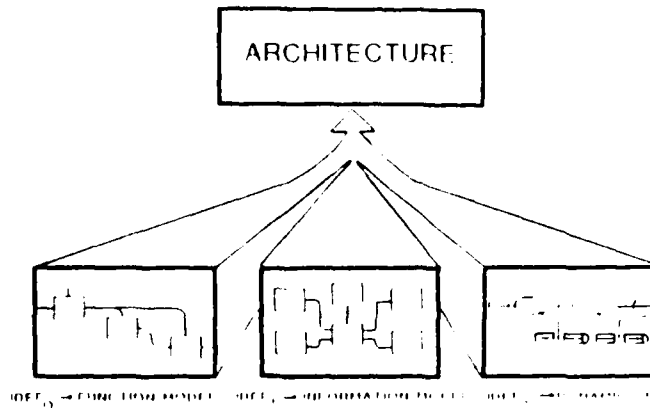
NARRATION: "IN SUMMARY, THE MANUFACTURING ARCHITECTURE PROVIDES BOTH A MANAGEMENT TOOL AND A TECHNICAL TOOL TO IMPROVE UNDERSTANDING AND COMMUNICATION.

"MANAGEMENT CAN USE THE ARCHITECTURE TO PLAN, ORGANIZE, AND CONTROL THE INTEGRATION OF NEW MANUFACTURING TECHNOLOGY.

"TECHNICAL PERSONNEL CAN USE THE ARCHITECTURE TO ANALYZE, INTEGRATE, SYSTEMATIZE AND DESIGN THE INTEGRATION OF NEW TECHNOLOGY.

"AND MAYBE MOST IMPORTANT, TO IMPROVE COMMUNICATION BETWEEN EACH OTHER!!!"

## ARCHITECTURE



59-1 33

INSTRUCTIONAL OBJECTIVE: To provide an understanding that all three IDEF<sub>0</sub>, IDEF<sub>1</sub>, and IDEF<sub>2</sub> modeling methodologies constitute the generic manufacturing architecture.

NARRATION: "INDIVIDUALLY AND COLLECTIVELY:

- 1) THE MFG0/IDEF<sub>0</sub> FUNCTION MODEL  
'A BLUEPRINT OF FUNCTIONS.'
- 2) THE MFG1/IDEF<sub>1</sub> INFORMATION MODEL  
'A BLUEPRINT OF FUNCTIONS.'

AND

- 3) THE MFG2/IDEF<sub>2</sub> DYNAMICS MODEL  
'A SCENARIO OF FUNCTION/INFORMATION INTERACTION.'

FORM THE ICAM ARCHITECTURE

EACH OF THE MODELS REPRESENT A DISTINCT BUT RELATED VIEW OF MANUFACTURING.

EACH USES A STRUCTURED IDEF METHOD TO BETTER UNDERSTAND, COMMUNICATE, AND ANALYZE EXISTING AND FUTURE MANUFACTURING.

EACH SUPPORTS THE DEVELOPMENT OF STATE-OF-THE-ART MANUFACTURING TECHNOLOGY AND INTEGRATION OF THAT TECHNOLOGY INTO EXISTING MANUFACTURING."

## ICAM OBJECTIVE

IDEF AND ARCHITECTURE ARE TOOLS .....

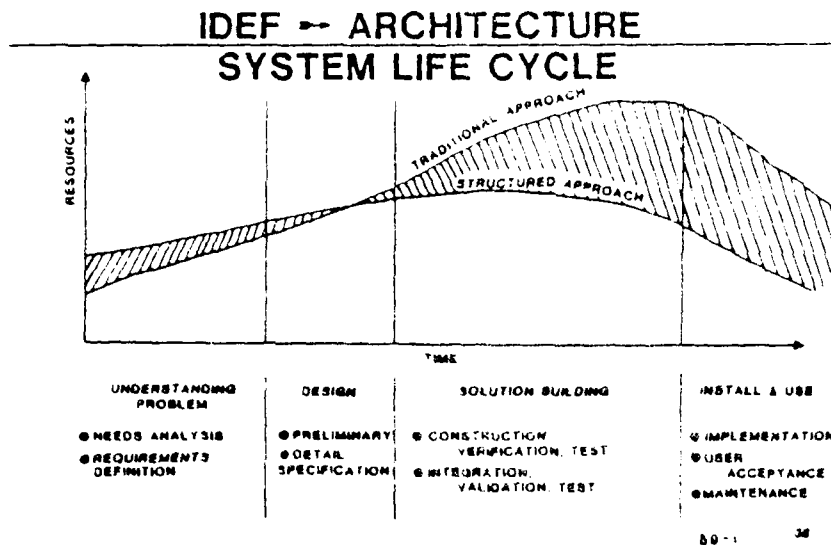
NOT OBJECTIVES

INSTRUCTIONAL OBJECTIVE: To provide an understanding that IDEF  
and architecture are a tool.

-----  
NARRATION: "LET'S KEEP IN MIND:

IDEF AND ARCHITECTURE ARE TOOLS --

NOT OBJECTIVES!!"



INSTRUCTIONAL OBJECTIVE: To provide an understanding of the relationship between ICAM IDEF/architecture and the ICAM system life cycle concept.

NARRATION: "WE UTILIZE THE IDEF SYSTEM DEFINITION METHODOLOGIES AND RESULTING ARCHITECTURE TO BETTER UNDERSTAND 'AS IS' PROBLEM AND DESIGN THE 'TO BE' SOLUTION.

"THIS APPROACH PROVIDES THE COMPUTER SYSTEM USERS WITH THE ABILITY TO DEFINE AND ARTICULATE THEIR REQUIREMENTS TO COMPUTER PEOPLE.

"THE STRUCTURED APPROACH OF BUILDING MODELS MAY INCREASE EARLY PROGRAM COSTS BUT IT WILL REDUCE OVERALL PROGRAM COSTS AND TIME SPAN.

(POINT TO SHADED AREAS OF CHART AS APPROPRIATE.)

"IT IS OUR BELIEF THAT ADDITIONAL EXPENDITURES OF RESOURCES EARLY IN THE PROGRAM 'UNDERSTANDING THE PROBLEM' AND 'DESIGNING THE SOLUTION' WILL MORE THAN OFFSET THE TRADITIONAL APPROACH COSTS EXPERIENCED IN THE PAST."

IDEF IS THE METHOD

ARCHITECTURE IS THE MEANS

PRODUCTIVITY IS THE OBJECTIVE

89-1 38

INSTRUCTIONAL OBJECTIVE: To provide an understanding of the relationship of IDEF, architecture, and productivity.

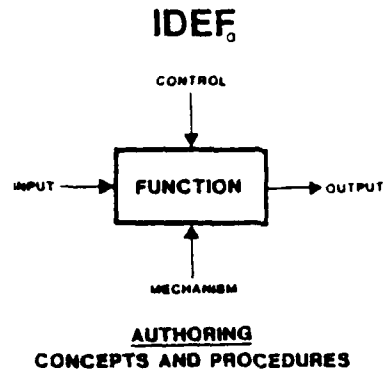
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NARRATION: "IDEF IS THE METHOD!!

ARCHITECTURE IS THE MEANS!!

PRODUCTIVITY IS THE OBJECTIVE!!"





59-4 1

TITLE SLIDE: IDEF<sub>0</sub> Authoring Concepts and Procedures

COURSE OBJECTIVE: To teach an understanding of the authoring concepts and procedures involved in IDEF<sub>0</sub> function modeling.

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NARRATION: "AN IDEF<sub>0</sub> FUNCTION MODEL GRAPHICALLY SHOWS OBJECTS AND/OR INFORMATION PERFORMED BY MEN AND/OR MACHINES THAT ENABLE YOU TO UNDERSTAND A SYSTEM."

**AUTHORING CONCEPTS  
AND PROCEDURES**

**LEARNING OBJECTIVES**

1. UNDERSTAND IDEF<sub>0</sub> (FUNCTION MODEL) GRAPHIC SYNTAX, I.E. SYMBOLS
2. UNDERSTAND THE BASIC CONCEPTS OF IDEF<sub>0</sub>
3. UNDERSTAND THE DIFFERENT USES THAT DATA CAN PLAY IN FUNCTION  
MODELING WITH IDEF<sub>0</sub>:
  - a. INPUTS
  - b. CONTROLS
  - c. OUTPUTS
  - d. MECHANISMS
4. UNDERSTAND IDEF<sub>0</sub> (FUNCTION MODEL) DIAGRAM DECOMPOSITION
5. UNDERSTAND AUTHORING AND REFINING IDEF<sub>0</sub>  
(FUNCTION MODEL) DIAGRAMS.

59-1 2

-----  
NARRATION: "COURSE LEARNING OBJECTIVES:

TO ENABLE YOU TO UNDERSTAND IDEF<sub>0</sub> FUNCTION MODELING  
IN TERMS OF:

- 1) BASIC CONCEPTS
- 2) GRAPHIC SYMBOLS
- 3) FUNCTIONS AND DATA
- 4) DIAGRAMS AND DECOMPOSITION
- 5) AUTHORING AND REFINING IDEF<sub>0</sub> FUNCTION MODEL  
DIAGRAMS"

AUTHORING CONCEPTS	DEFINITIONS AND EXAMPLES
<p><u>DEFINITIONS</u></p> <p><u>SYNTAX</u> IE SYMBOLS:</p> <ul style="list-style-type: none"> <li>• STRUCTURAL COMPONENTS OR "SYMBOLS"</li> <li>• RULES THAT DEFINE RELATIONS AMONG THE COMPONENTS</li> </ul>	<p><u>EXAMPLES IN IDEF<sub>0</sub></u></p> <p><u>SYMBOLS</u>:</p> <ul style="list-style-type: none"> <li>• BOXES</li> <li>• ARROWS</li> </ul> <p><u>RULES</u>:</p> <ul style="list-style-type: none"> <li>• "USE ONLY 3-6 BOXES IN A DIAGRAM LAYOUT"</li> </ul>
<p><u>SEMANTICS</u> IE CONCEPTS:</p> <ul style="list-style-type: none"> <li>• MEANING OF SYNTACTIC COMPONENTS</li> <li>• INTERPRETATION OF SYNTACTIC RULES</li> </ul>	<p><u>CONCEPTS</u>:</p> <ul style="list-style-type: none"> <li>• FUNCTIONS BOXES</li> <li>• INTERFACE-CONSTRAINTS ARROWS</li> <li>• "USE ONLY 3-6 BOXES IN A DIAGRAM LAYOUT"</li> <li>• LESS THAN 3 BOXES -NOT ENOUGH DETAIL</li> <li>• MORE THAN 6 BOXES -CLUTTERS AND DETRACTS FROM READABILITY</li> </ul>

58-2 3

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the basic concepts of IDEF<sub>0</sub> function modeling.

CONCEPT: IDEF<sub>0</sub> function modeling communicates by using symbols put together in a structured way to give meaning.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture Part II, Volume IV - Function Modeling Manual (IDEF<sub>0</sub>)

SEE: "SYNTAX," Section 6, #6.6.1, Pg. 106  
"SEMANTICS," Section 6, #6.6.1, Pg. 106

NARRATION: SYNTAX AND SEMANTICS

"IN THE IDEF<sub>0</sub> CONTEXT SYNTAX RELATES TO THE ORDER OF SYMBOLS AND RULES USED TO COMMUNICATE INFORMATION IN IDEF<sub>0</sub> FUNCTION MODELING.

"IN THE IDEF<sub>0</sub> CONTEXT SEMANTICS REFERS TO THE 'MEANING' OF THE IDEF<sub>0</sub> SYMBOLS AND RULES."

AUTHORING CONCEPTS | FUNCTION

"FUNCTION"

DEFINITION:

- AN ACTIVITY, ACTION, PROCESS, OPERATION
- A DESCRIPTION OF "WHAT HAPPENS" IN A PARTICULAR ENVIRONMENT - WHAT IT MEANS TO DO SOMETHING.
- FUNCTIONS THAT ARE DONE BY PEOPLE, MACHINES, COMPUTERS, ETC.

CHARACTERISTICS:

- ACTIVE VERB OR VERB PHRASE
- OCCURS OVER TIME
- RECOGNIZABLE RESULTS

50-2 4

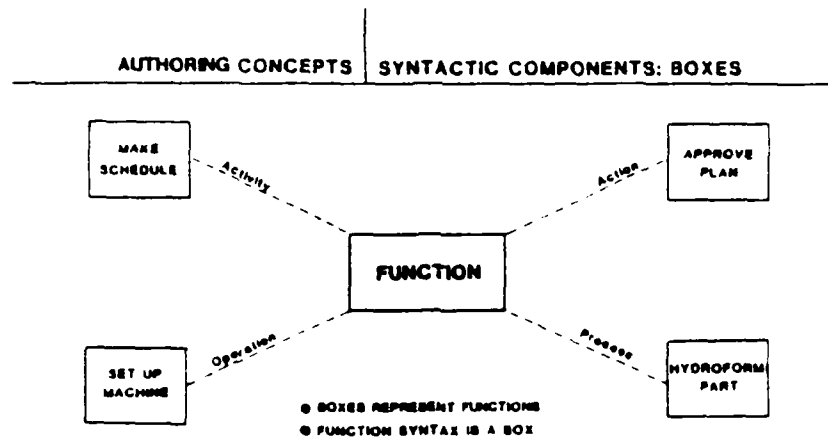
INSTRUCTIONAL OBJECTIVE: To teach an understanding of "function" in the IDEF0 context.

CONCEPT: A function is a coordinated activity, process action, or operation used to accomplish a specific end.

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NARRATION: "THE DEFINITION OF A FUNCTION IN IDEF0 MODELING IS: AN ACTIVITY, ACTION, PROCESS, OR OPERATION THAT DESCRIBES WHAT HAPPENS IN A PARTICULAR ENVIRONMENT, THAT IS A DESCRIPTION OF WHAT IT MEANS TO DO SOMETHING. THESE FUNCTIONS ARE DONE BY PEOPLE, MACHINES, COMPUTERS.

"WE NAME A FUNCTION WITH AN ACTIVE VERB AND A VERB PHRASE. A FUNCTION IS AN ACTIVITY, ACTION, PROCESS, OR OPERATION THAT OCCURS OVERTIME, AND IT PRODUCES RECOGNIZABLE RESULTS."



58-2 8

INSTRUCTIONAL OBJECTIVE: To teach an understanding of "boxes" as symbols representing functions in the IDEF<sub>0</sub> function modeling methodology.

CONCEPT: If we have a standard symbolic way of representing functions we can begin to model functions.

NARRATION: "A FUNCTION IS ALWAYS REPRESENTED GRAPHICALLY WITH A BOX IN THE IDEF<sub>0</sub> FUNCTION MODEL DIAGRAM."

REINFORCEMENT:

"A FUNCTION CAN BE AN ACTIVITY, AN OPERATION, AN ACTION, OR A PROCESS."

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AUTHORING CONCEPTS DATA

---

DEFINITION

- INFORMATION / PHYSICAL OBJECTS

CHARACTERISTICS

- NOUN OR NOUN PHRASE

RELATIONSHIP TO FUNCTION

- UNDERGO CHANGES BY FUNCTION
- DETERMINE OR AFFECT FUNCTION
- RESULT FROM FUNCTION
- CARRY OUT FUNCTION

89-2 8

INSTRUCTIONAL OBJECTIVE: To teach an understanding of data definition characteristics, and relationships in IDEF0 function modeling.

CONCEPT: Data is information or physical objects involved in an activity, process, action, or operation.

-----  
NARRATION: "DATA IS THE INFORMATION AND THE PHYSICAL OBJECTS THAT ARE RELATED TO FUNCTIONS.

"DATA IS NAMED WITH A NOUN OR NOUN PHRASE: EXAMPLE;

- o RAW MATERIALS
- o PRODUCT
- o WORK ORDER"

AUTHORING CONCEPTS DATA: PRIOR TO/RESULTING  
FROM ACTIVATION OF FUNCTION

DATA PRIOR TO ACTIVATION OF FUNCTION	FUNCTION	DATA RESULTING FROM ACTIVATION OF FUNCTION
● PRODUCT MANUFACTURING REQUIREMENTS	● PLAN FOR MANUFACTURE	● MANUFACTURING PLAN
● PRODUCT SPECIFICATIONS	● PRODUCE PRODUCT	● PRODUCT
● RAW MATERIALS ● BLUEPRINTS ● WORK ORDERS ● INSTRUCTIONS	● MAKE PART	● FABRICATED PARTS ● SCRAP

INSTRUCTIONAL OBJECTIVE: To teach an understanding of data prior to and resulting from an activation of a function.

CONCEPT: Something happens to data as a result of a function's activation.

NARRATION: "WHEN THE FUNCTION (POINT TO IT) 'PLAN FOR MANUFACTURE' IS ACTIVATED, THE REQUIREMENTS FOR MANUFACTURING A PRODUCTION RESULTS IN A MANUFACTURING PLAN."

"WHEN THE FUNCTION, 'PRODUCE PRODUCT' (POINT TO IT) IS ACTIVATED, THE PRODUCT SPECIFICATIONS RESULT IN A PRODUCT."

"WHEN THE FUNCTION, 'MAKE PART' (POINT TO IT) IS ACTIVATED, THE RAW MATERIALS, BLUE PRINTS, WORK ORDERS, AND INSTRUCTIONS RESULT IN FABRICATED PARTS AND LEFTOVERS."

AUTHORING CONCEPTS	USES OF DATA: INPUTS, CONTROLS, OUTPUTS AND MECHANISMS
--------------------	---

INPUT: DATA WHICH UNDERGOES A CHANGE  
AND IS TRANSFORMED

CONTROL: DATA WHICH INFLUENCES OR DETERMINES  
THE FUNCTION OUTPUT(S)

OUTPUT: DATA WHICH RESULTS FROM A FUNCTION;  
DATA CREATED BY A FUNCTION

MECHANISM: DATA WHICH CARRIES OUT A FUNCTION

50-1 8

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the different uses of data in IDEF<sub>0</sub> function modeling.

CONCEPT: Data as information or physical objects has four differing uses in IDEF<sub>0</sub> function modeling.

NARRATION: "DATA CAN BE USED AS AN INPUT, A CONTROL, AN OUTPUT, OR A MECHANISM EACH RELATED IN A SPECIFIC ROLE TO A FUNCTION."

(GIVE DEFINITIONS ON FOIL.)



AUTHORING CONCEPTS DATA ROLES IN IDEF<sub>0</sub>

INPUT(S)	CONTROL(S)	FUNCTION	OUTPUT(S)
● PROCURABLE ITEMS	● PRODUCT DESIGN	● MANUFACTURE PRODUCT	● PRODUCT
● RAW MATERIALS	● BLUEPRINT ● WORKORDER ● INSTRUCTIONS	● MAKE PART	● FABRICATED PART ● SCRAP
● EXPERIENCE & CAPABILITY INFORMATION	● RESOURCE REQUIREMENTS	● ESTIMATE RESOURCE NEEDS	● RESOURCE PLANS

"INPUT" DATA

"OUTPUT" DATA

89-4 1 8

INSTRUCTIONAL OBJECTIVE: To teach an understanding of data in terms its functions as input data, control data, and output data in IDEF<sub>0</sub> function modeling.

CONCEPT: Information plays four differing roles in IDEF<sub>0</sub> function modeling

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture Part II, Volume IV - Function Modeling Manual (IDEF<sub>0</sub>)

SEE: "BOX/ARROW RELATIONSHIP," Section 3, #3.3.1, pg. 22

NARRATION: "EXAMPLES OF SOME OF DATA'S USES IN THE FUNCTION, 'MANUFACTURE PRODUCT' THE PHYSICAL OBJECTS, PROCURABLE ITEMS ARE INPUTS BECAUSE THEY UNDERGO A TRANSFORMATION. (SAME FOR RAW MATERIALS, EXPERIENCE AND CAPABILITY INFORMATION.) PRODUCT DESIGN IS A CONTROL TO FUNCTION, MANUFACTURING PRODUCT BECAUSE IT DETERMINES THE RESULTING PRODUCT (SAME FOR BLUE PRINT, WORK ORDER, INSTRUCTIONS.)

"THE OUTPUT PRODUCT OF THE FUNCTION MANUFACTURING PRODUCT IS THE RESULT OF THE PROCESS OF MANUFACTURING PRODUCT AND INFLUENCE OF INPUTS AND CONTROLS ON THAT FUNCTION."

AUTHORING CONCEPTS | MECHANISM

DEFINITION:

- THE MEANS BY WHICH A FUNCTION IS DONE
- THE ORIGIN, SOURCE, OR AGENT THAT ENABLES A FUNCTION TO BE ACCOMPLISHED

CHARACTERISTICS:

- NOUN OR NOUN PHRASE
- TYPICALLY A PERSON, MACHINE, OR COMPUTER

89-4 10

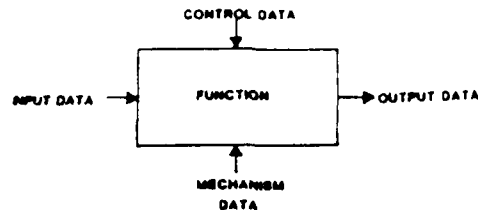
INSTRUCTIONAL OBJECTIVE: To teach an understanding of data in terms of its function as a mechanism.

CONCEPT: Functions need a means by which they can accomplish their objectives.

-----  
NARRATION: "THE MECHANISM OF A FUNCTION IS ALWAYS THE MEANS BY WHICH A FUNCTION'S OBJECTIVE IS ACCOMPLISHED. AN EXAMPLE WOULD BE A TEAM, PEOPLE -- A LATHE, A MACHINE, OR SYSTEM 2000 -A COMPUTER."

AUTHORING CONCEPTS | SYNTACTIC  
COMPONENTS: ARROWS

- ARROWS REPRESENT DATA
- ARROWS ALWAYS CONNECT TO A BOX



- DATA SYNTAX IS AN ARROW

50-4 11

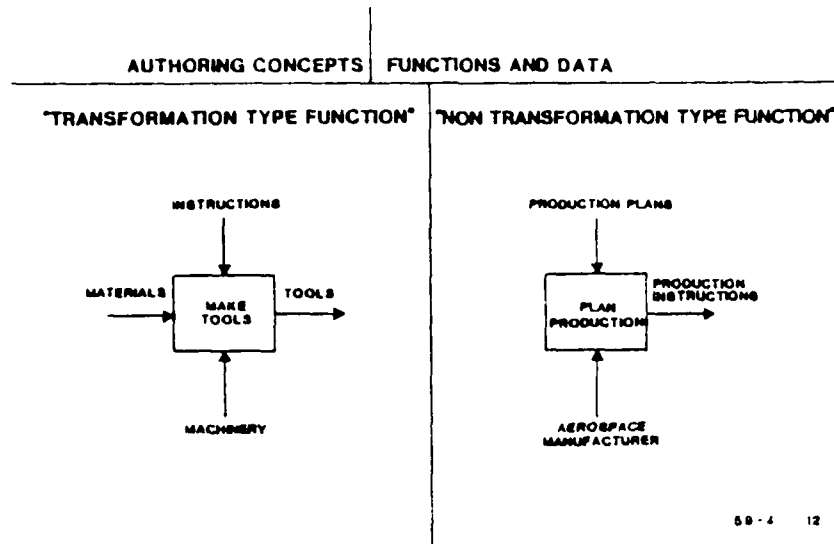
INSTRUCTIONAL OBJECTIVE: To teach an understanding of the data symbols and syntax used in IDEF0 function modeling.

CONCEPT: By using standard symbols put together in a structured way to describe data symbolically, we can communicate the uses of data in IDEF0 function modeling.

NARRATION: "INPUT DATA, CONTROL DATA, OUTPUT DATA, AND MECHANISM DATA ARE ALL REPRESENTED BY ARROWS CONNECTED TO OTHER FUNCTIONS (CALLED ICOM CODES).

- I INPUT - ALWAYS GOES IN FROM THE LEFT SIDE OF FUNCTION BOX
- C CONTROL - ALWAYS GOES IN FROM THE TOP OF FUNCTION BOX
- O OUTPUT - ALWAYS GOES OUT FROM THE RIGHT SIDE OF FUNCTION BOX
- M MECHANISM - ALWAYS GOES IN FROM THE BOTTOM OF THE FUNCTION BOX

THE INPUT DATA (ON THE LEFT) ARE TRANSFORMED INTO OUTPUT DATA (ON THE RIGHT). CONTROL DATA (ON THE TOP) GOVERN THE WAY IN WHICH THE FUNCTION IS DONE. MECHANISM DATA (ON THE BOTTOM) INDICATE THE MEANS BY WHICH THE FUNCTION IS PERFORMED."



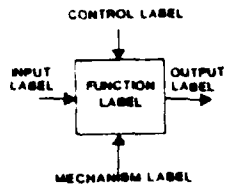
59-4 12

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the graphic symbols used in modeling functions and data in IDEF<sub>0</sub> function modeling.

CONCEPT: There is a standard symbolic means for representing functions and data in IDEF<sub>0</sub> function modeling.

NARRATION: "ON THE LEFT IS A MANUFACTURING EXAMPLE WITH THE FUNCTION NAMED AS "MAKE TOOLS," A VERB PHRASE; AND THE DATA ARROWS NAMED BY NOUNS; MATERIALS, INSTRUCTIONS, TOOLS MACHINERY - LEARN TO READ THEM CLOCKWISE, ALWAYS STARTING WITH THE LEFT ... (INPUT). ON THE RIGHT IS A MANUFACTURING EXAMPLE - THERE IS NO INPUT DATA ... THE OUTPUT 'PRODUCTION INSTRUCTIONS' RESULTS FROM THE INTERFACE OF PRODUCTION PLANS AND AEROSPACE MANUFACTURER."

## AUTHORING CONCEPTS LABELS



- LABELS ARE WORDS THAT NAME FUNCTIONS AND DATA
- FUNCTION LABELS ARE VERBS OR VERB PHRASES AND ARE PUT IN THE CENTER OF THE FUNCTION BOX
- DATA LABELS ARE NOUNS OR NOUN PHRASES
- DATA LABELS ARE ASSOCIATED WITH INPUT, CONTROL, OUTPUT, AND MECHANISM ARROWS
- DATA LABELS ARE PLACED AS NEAR TO THEIR RESPECTIVE ARROWS AS POSSIBLE

THE CHOICE OF WORDS IN NAMING LABELS IS CRITICAL I

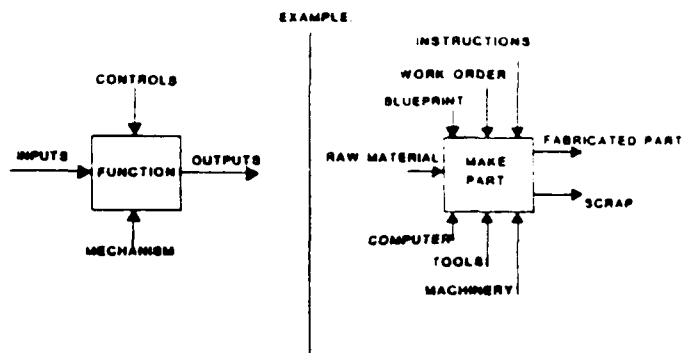
88-2 13

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the function of labels in IDEF<sub>0</sub> function modeling.

CONCEPT: In order to maintain a standard for communication, IDEF<sub>0</sub> function modeling employs names (called labels) for all function boxes and data arrows.

NARRATION: "ALL FUNCTION BOXES MUST BE LABELED WITH VERBS OR VERB PHRASES, AND ALL DATA ARROWS MUST BE LABELED WITH NOUNS OR NOUN PHRASES."

# AUTHORING CONCEPTS: FUNCTIONS, DATA AND LABELS



89-2 14

INSTRUCTIONAL OBJECTIVE: To teach an understanding of IDEF<sub>0</sub> graphic symbols and syntax for functions, data, and labels in the IDEF<sub>0</sub> modeling methodology.

CONCEPT: Functions, data, and labels all work together to communicate their interrelationships in graphic terms.

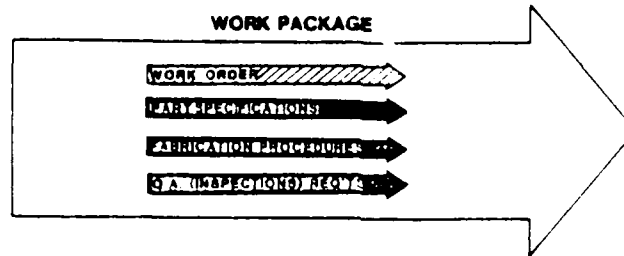
NARRATION: LEFT: "IDEF<sub>0</sub> NOTATION, READ CLOCKWISE STARTING WITH INPUT, CONTROLS, OUTPUT, AND MECHANISMS.

RIGHT: "LABELS TELL US THE NAMES OF THE FUNCTION BOXES AND THE DATA ARROWS."

AUTHORING CONCEPTS | DATA ARROWS: "PIPELINES"

INPUT OUTPUT AND CONTROL ARROWS REPRESENT  
'CLASSES' OR 'CATEGORIES' OF DATA

ANALOGY < ● PIPE LINES  
● COAXIAL CABLES



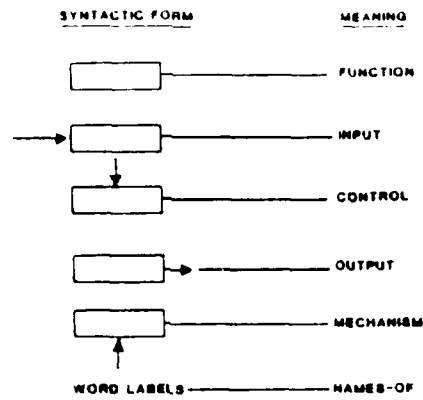
50-2 10

INSTRUCTIONAL OBJECTIVE: To teach an understanding of how data arrows can represent more than one category of related data.

CONCEPT: More than one kind of data can pass through the same data arrow.

NARRATION: "THINK OF THE ARROWS REPRESENTING DATA AS HOLLOW PIPE LINES THAT CAN CARRY MORE THAN ONE KIND OF RELATED INFORMATION AT ONE TIME, OR A COAXIAL CABLE THAT CARRIES A MULTIPLEX SIGNAL."

AUTHORING CONCEPTS | SYNTAX COMPONENTS: REVIEW



58-4 18

INSTRUCTIONAL OBJECTIVE: To review syntactic components.

-----  
DIRECTIONS: COVER AND REVEAL ONE AT A TIME.



# AUTHORING CONCEPTS EXERCISE

## INSTRUCTIONS

BASED ON THE NARRATIVE, IDENTIFY TERMS WHICH DESCRIBE FUNCTIONS, INPUTS, CONTROLS, OUTPUTS AND MECHANISMS. LIST THE TERMS IN THE APPROPRIATE SPACES BELOW.

## NARRATIVE

BUILD A MODEL AIRPLANE, GIVEN A KIT WHICH CONTAINS MATERIALS AND INSTRUCTIONS. THE KIT INCLUDES THE FOLLOWING ITEMS:

- PRINTED PAMPHLET WITH STEP-BY-STEP INSTRUCTIONS
- GLUE
- RUBBER BAND (FOR PROPULSION)
- Balsa WOOD
- PAINT
- DECAL
- APPLICATORS FOR PAINT AND GLUE

FUNCTIONS	INPUTS	CONTROLS	OUTPUTS	MECHANISMS

17  
 AB-2

INSTRUCTIONAL OBJECTIVE: To give an exercise in IDEF<sub>0</sub> authoring concepts to reinforce what has been taught.

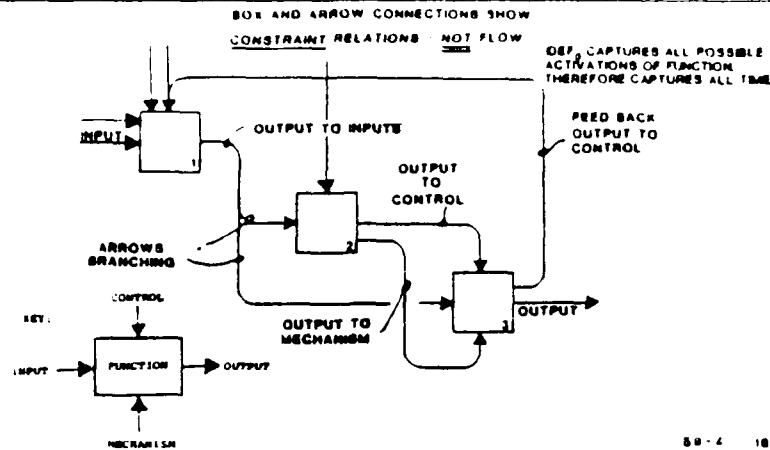
DIRECTIONS: ORGANIZE THE MODEL AIRPLANE KIT ITEMS INTO:

- o FUNCTIONS
- o INPUTS
- o CONTROLS
- o OUTPUTS
- o MECHANISMS

8 September 1983

## AUTHORING CONCEPTS

**BOX AND ARROW RELATIONS:  
CONSTRAINTS**



INSTRUCTIONAL OBJECTIVE: To teach an understanding of box and arrow meanings and their relations in an IDEF<sub>0</sub> function model diagram.

CONCEPT: Data constrains functions in a specific way according to the IDEF<sub>0</sub> function modeling methodology.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER  
AIDED MANUFACTURING (ICAM), Archi-  
tecture Part II, Volume IV - Function  
Modeling Manual (IDEF0)

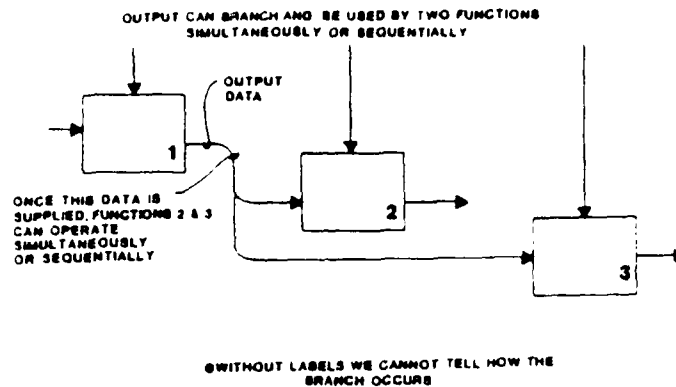
SEE: "BOX/ARROW RELATIONSHIP," Section 3,  
#3.3.1, pg. 24

NARRATION: "LOOK AT THE KEY: INPUT, CONTROL, OUTPUT, AND MECHANISM."

"ABOVE IS A SIMPLE IDEF0 FUNCTION MODEL DIAGRAM SHOWING THE POSSIBLE ACTIVATION OF THREE FUNCTIONS, REPRESENTED BY BOXES NUMBERED 1, 2, AND 3, AND DATA REPRESENTED BY ARROWS.

"THESE ARE THE DIFFERENT WAYS ARROWS ARE USED WITH BOXES TO SHOW CONSTRAINTS ... INPUT (POINT), OUTPUT (POINT), OUTPUT TO INPUTS (POINT), OUTPUT TO CONTROL (POINT), OUTPUT TO MECHANISM (POINT), FEEDBACK OUTPUT TO CONTROL."

AUTHORING CONCEPTS    ARROWS: 'BRANCHING'



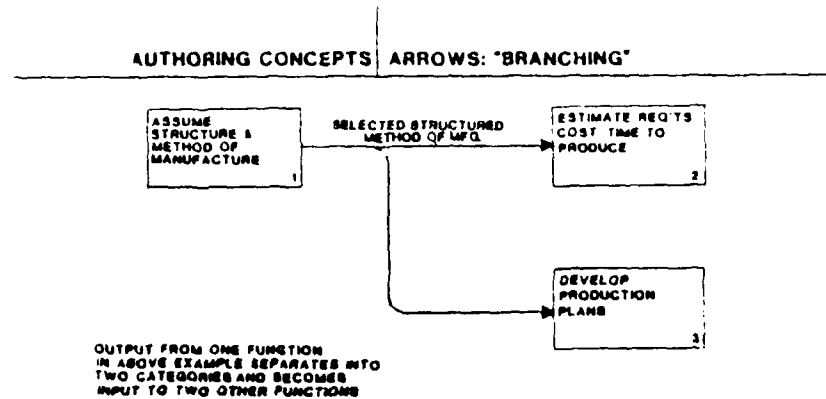
59-4 18

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the way  
output data arrows can branch.

CONCEPT: The same output data is sometimes used  
by two functions.

NARRATION: "IN THIS EXAMPLE WE SEE THAT THE SAME OUTPUT PRODUCED  
FROM A FUNCTION (BOX 1) IS USED BY FUNCTION #2 AND  
FUNCTION #3.

"THE LABELS TELL US HOW THE BRANCHING OF INFORMATION  
OCCURS."

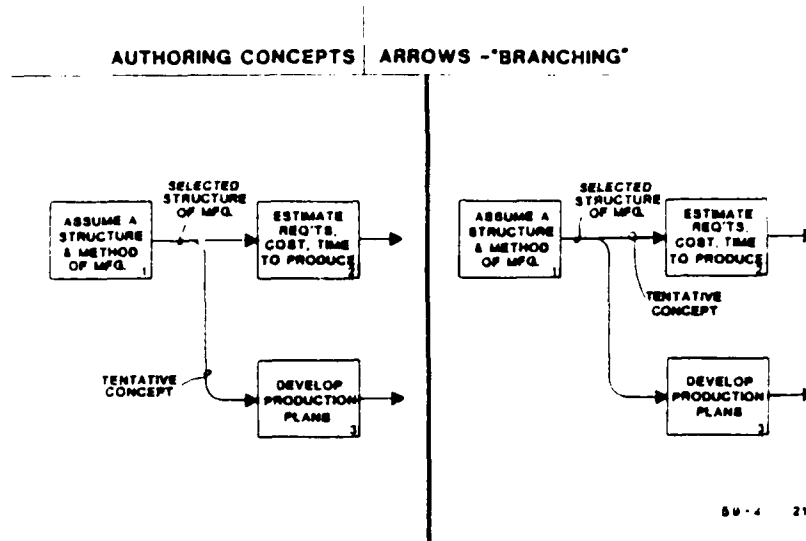


59-2 20

INSTRUCTIONAL OBJECTIVE: To show a manufacturing example of an output branching and to reinforce branching concept.

CONCEPT: The same output data is sometimes used by two functions.

NARRATION: "IN THIS MANUFACTURING EXAMPLE, THE OUTPUT FROM FUNCTION #1, ASSUME STRUCTURE AND METHOD OF MANUFACTURING (POINT TO IT) WHICH IS SELECTED STRUCTURED METHOD OF MANUFACTURING (POINT TO IT) BECOMES OUTPUT TO TWO OTHER FUNCTIONS, ESTIMATE REQUIREMENTS, COST, TIME TO PRODUCE, (POINT TO IT) AND DEVELOP PRODUCTION PLANS."



INSTRUCTIONAL OBJECTIVE: To show a manufacturing example of arrows branching and to reinforce branching concept.

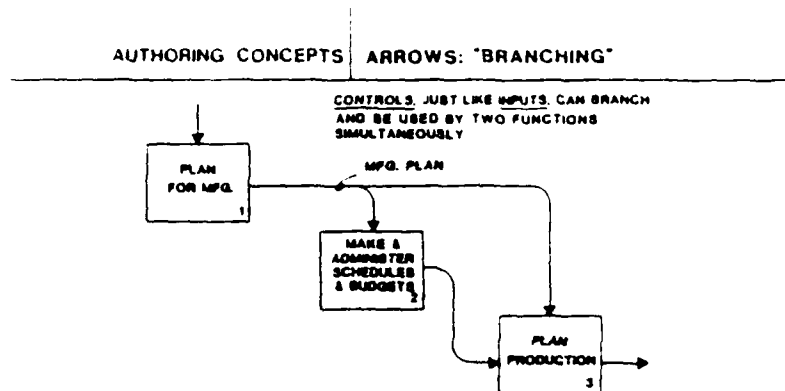
CONCEPT: The same output data is sometimes used by two functions.

NARRATION: "IN THESE EXAMPLES, THE SAME OUTPUT BRANCHES OFF INTO TWO DIFFERING CATEGORIES OF INFORMATION AND IS LABELED ACCORDINGLY.

(POINT TO EXAMPLES AND EXPLAIN DIFFERENCE)

(LEFT SIDE) ... OUTPUT FROM FUNCTION #1, ASSUME A STRUCTURE OF MANUFACTURING BRANCHES INTO TWO DIFFERING CATEGORIES "SELECTED STRUCTURE OF MANUFACTURING GOES INTO FUNCTION #2, ESTIMATE REQUIREMENTS, COST, TIME TO PRODUCE; WHILE 'TENTATIVE CONCEPT' GOES INTO FUNCTION #3, DEVELOP PRODUCTION PLANS."

(SAME KIND OF EXPLANATION FOR RIGHT SIDE)



80-2 22

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the way control data arrows can branch.

CONCEPT: The same control data is sometimes used by two functions.

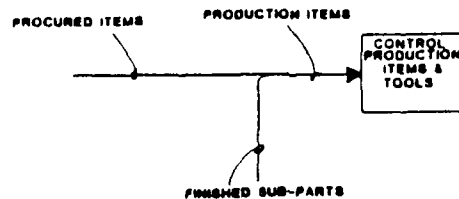
NARRATION: "THE OUTPUT 'MANUFACTURING PLAN' FROM FUNCTION #1, PLAN FOR MANUFACTURING BECOMES A CONTROL TO FUNCTION #2 AND FUNCTION #3 AND CAN BRANCH JUST LIKE INPUTS."

---

AUTHORING CONCEPTS | ARROWS - "JOINING"

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EXAMPLE.



59-2 23

INSTRUCTIONAL OBJECTIVE: To teach an understanding of how data arrows can join together.

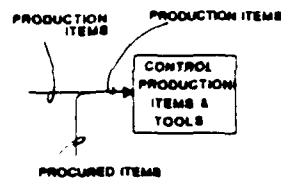
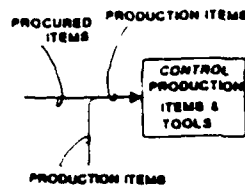
CONCEPT: Two categories of input data arrows can join together to become input to one function.

-----  
NARRATION: "IN THIS MANUFACTURING EXAMPLE, THE INPUTS OF 'PRODUCTION ITEMS' (POINT TO THEM) AND 'FINISHED SUB-PARTS' JOIN TOGETHER TO BECOME THE INPUT KNOWN AS 'PROCURED ITEMS.'"

"THE LABELS TELL US HOW THE JOINING OCCURS."

AUTHORING CONCEPTS    ARROWS - "JOINING"

OTHER VALID FORMS



59-4 24

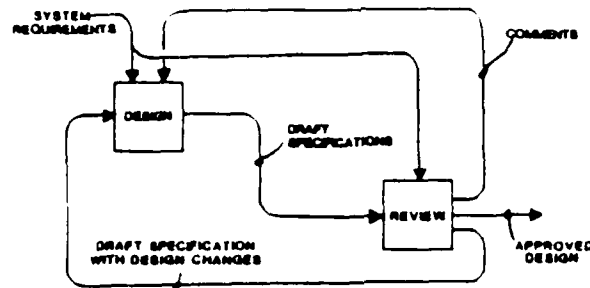
INSTRUCTIONAL OBJECTIVE: To show a manufacturing example of how arrows can join together.

CONCEPT: Two categories of input data arrows can join together to become input to one function.

NARRATION: "THESE MANUFACTURING EXAMPLES SHOW HOW TWO CATEGORIES OF INPUT DATA CAN JOIN TOGETHER TO BECOME INPUT TO ONE FUNCTION."



AUTHORING CONCEPTS ARROWS-"FEEDBACK"



89-4 28

INSTRUCTIONAL OBJECTIVE: To teach an understanding of how data that feeds back is represented graphically with arrows in IDEF0 function modeling.

CONCEPT: Certain data may become altered after discussion with involved personnel and feedback to become reprocessed.

NARRATION: "IN THIS MANUFACTURING EXAMPLE 'COMMENTS' FROM THE REVIEW FUNCTION FEEDBACK TO THE DESIGN FUNCTION AS A CONTROL (POINT TO IT) WHILE 'DRAFT SPECIFICATIONS WITH DESIGN CHANGES' FEEDBACK FROM THE REVIEW FUNCTION TO THE DESIGN FUNCTION AS AN INPUT (POINT TO IT).

- o CONTROL DATA FEEDBACK ARROWS ALWAYS GO OUT AND OVER.
- o INPUT DATA FEEDBACK ARROWS ALWAYS GO OUT AND UNDER."

---

AUTHORING CONCEPTS | DECOMPOSITION

---

- FUNCTIONS ARE COMPRISED OF SUBFUNCTIONS
- DECOMPOSITION IS AN "EXPLOSION" OF DETAIL (LEVEL BY LEVEL)
- DATA CONSISTENCY IS REQUIRED (LEVEL BY LEVEL)
- ESTABLISHES MODEL HIERARCHY AND NODE NUMBERING

59-2 20

INSTRUCTIONAL OBJECTIVE: To teach an understanding of IDEF0 function model decomposition.

CONCEPT: Decomposition is a breakdown process. Decomposition always proceeds from higher to lower levels to uncover detail.

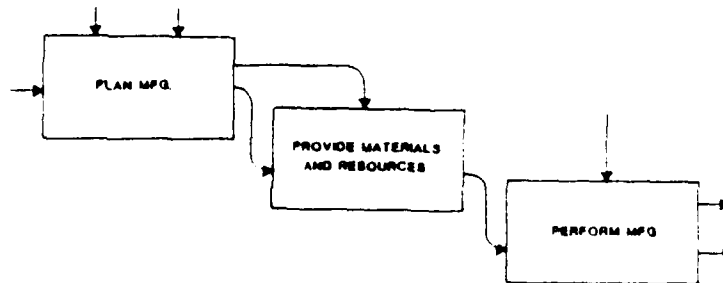
REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture-Part II, Volume IV - Function Modeling Manual (IDEF0)

SEE: "Communication by Gradual Exposition of Detail." Section 2, #2.3.2, pg. 12

-----  
NARRATION: "DECOMPOSITION IS A BREAKDOWN OF A PROCESS, OPERATION, ACTION, OR ACTIVITY FROM THE TOP-DOWN."

(TALK TO CHART)

AUTHORING CONCEPTS | DECOMPOSITION



84-2 27

INSTRUCTIONAL OBJECTIVE: To teach an understanding of IDEF<sub>0</sub> function model decomposition.

CONCEPT: A function contains sub-functions in lower levels of decomposition.

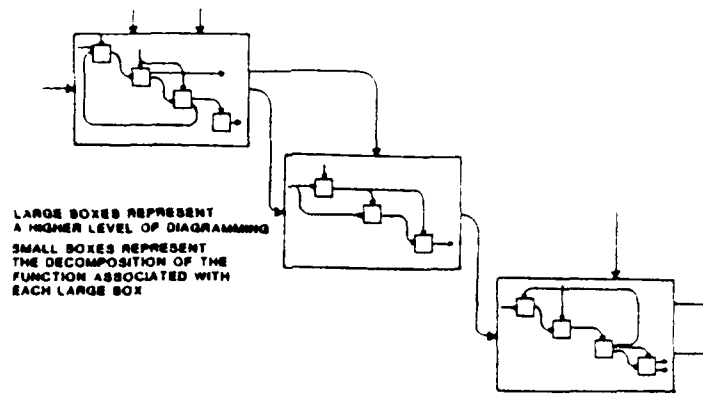
REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture Part II, Volume IV - Function Modeling Manual (IDEF<sub>0</sub>)

SEE: "Communication by Gradual Exposition of Detail." Section 2, #2.3.2, pg. 12

NARRATION: "THESE ARE THE SUBFUNCTIONS CONTAINED IN A TOP-DOWN-STRUCTURE BREAKDOWN OF THE FUNCTION:

MANUFACTURE PRODUCT"

# AUTHORING CONCEPTS | DECOMPOSITION



69-2 28

INSTRUCTIONAL OBJECTIVE: To teach an understanding of IDEF<sub>0</sub> function model decomposition.

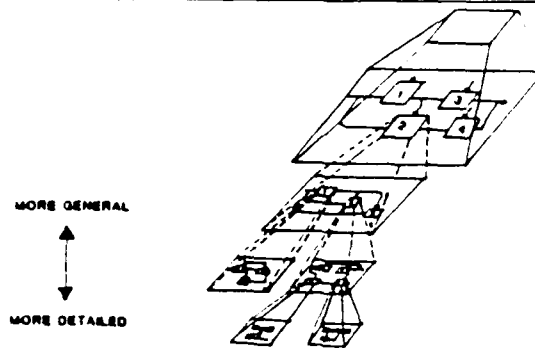
CONCEPT: Decomposition always occurs in a general to detailed manner.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture-Part II, Volume IV - Function Modeling Manual (IDEF<sub>0</sub>)

SEE: "Communication by Gradual Exposition of Detail." Section 2, #2.3.2, pg. 12

NARRATION: "DIAGRAM REPRESENTATION OF TOP-DOWN-STRUCTURE BREAK-DOWN ALWAYS PROCEEDS FROM A MORE GENERAL TO MORE DETAILED VIEW IN WHICH LARGER BOXES REPRESENT A HIGHER LEVEL OF DIAGRAMMING AND SMALLER BOXES REPRESENT THE DECOMPOSITION OF THE FUNCTION ASSOCIATED WITH EACH LARGER BOX."

AUTHORING CONCEPTS | DECOMPOSITION



59-1 20

INSTRUCTIONAL OBJECTIVE: To teach an understanding of IDEF<sub>0</sub> function model decomposition.

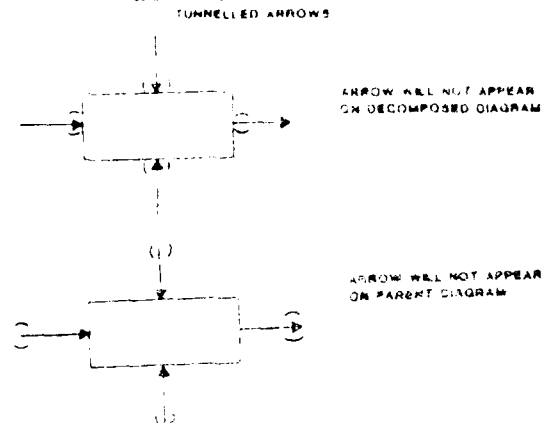
CONCEPT: Decomposition always occurs in a general to detailed manner.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture-Part II, Volume IV - Function Modeling Manual (IDEF<sub>0</sub>)

SEE: "Communication by Gradual Exposition of Detail." Section 2, #2.3.2, pg. 12

NARRATION: "TOP-DOWN-STRUCTURE BREAKDOWN ALWAYS PROCEEDS FROM A MORE GENERAL TO A MORE DETAILED VIEW."

# AUTHORING CONCEPTS DECOMPOSITION



50-2 30

INSTRUCTIONAL OBJECTIVE: To teach an understanding of what happens to certain data in the decomposition process.

CONCEPT: Tunnelled arrows indicate that the data conveyed by these arrows is not relevant to a particular level of detail.

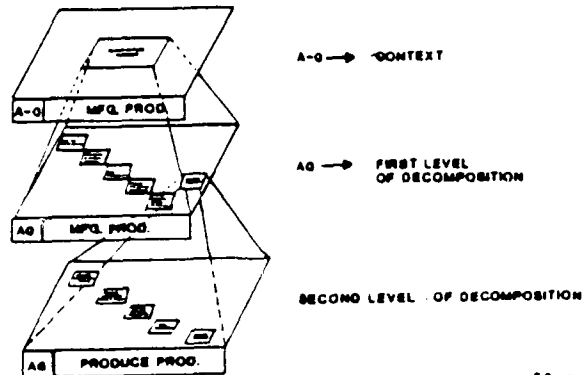
REFERENCE: AFWAL-TR-81-4000 INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture-Part II, Volume IV - Function Modeling Manual (IDEF0)

SEE: "Tunnelled Arrows," Section 3, #3.2.5, pg. 38

NARRATION: "SOMETIMES WE WANT TO SHOW AS MUCH DATA AS POSSIBLE ON THE HIGHEST LEVEL DIAGRAM. IF WE FIND THAT OUR PROJECT SCOPE IS NOT CONCERNED WITH ALL THE DATA WE HAVE INDICATED, WE HAVE A CONVENTION FOR SHOWING DATA AT HIGHER LEVELS AND DROPPING IT ALTOGETHER OR HAVING IT DISAPPEAR AND REAPPEAR LATER AT A LOWER LEVEL OF DECOMPOSITION."

## AUTHORING CONCEPTS | DECOMPOSITION

A MODEL ORGANIZES DIAGRAMS INTO A  
STRUCTURED DECOMPOSITION



59-4 31

INSTRUCTIONAL OBJECTIVE: To show examples of decomposition in a manufacturing environment.

CONCEPT: Decomposition always occurs in a top-down manner, proceeding from a more general to a more detailed level.

NARRATION: "IN A MANUFACTURING CONTEXT MORE GENERAL PROCEEDS FROM AN A-0 CONTEXT (THE WHOLE SYSTEM) TO THE A0 CONTEXT (FIRST LEVEL OF DECOMPOSITION) TO THE A1 - A6 (SECOND LEVEL OF DECOMPOSITION)."

AFWAL-TR-81-4023  
9 September 1983

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AUTHORING CONCEPTS    NODE NUMBER

---

INDICATES

- DIAGRAM, TEXT, FIG. GLOSSARY
- LEVEL OF HIERARCHY (DECOMPOSITION)
- PARENT DIAGRAM
- LOCATION IN PARENT DIAGRAM

89-1 32

INSTRUCTIONAL OBJECTIVE: To teach an understanding of how Node numbers function in IDEF0 function modeling.

CONCEPT: We need a way to differentiate among different levels of decomposition.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture-Part II, Volume IV - Function Modeling Manual (IDEF0)

SEE: "Node Number," Section 3, #3.2.1.1, pg. 32

-----

NARRATION: "NODE NUMBERS HELP TO MAINTAIN CONSISTENCY OF FUNCTION MODEL DIAGRAMS FOR BOTH MODELERS AND REVIEWERS."



AUTHORING CONCEPTS	NODE NUMBER
--------------------	-------------

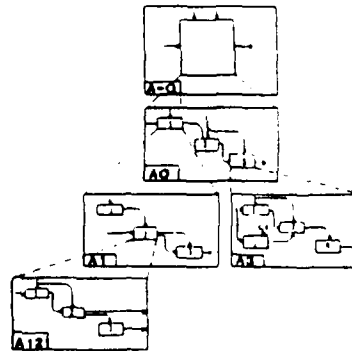
NODE NUMBER CORRESPONDS TO  
POSITION IN HIERARCHY

A-0: TOP LEVEL (CONTEXT)

A0 = FIRST LEVEL

A1, PARTIAL  
A3, DECOMPOSITION  
OF A0

A12 = PARTIAL  
DECOMPOSITION  
OF A1



80-4 33

INSTRUCTIONAL OBJECTIVE: To show example of how node numbers are used in IDEF0 function model diagrams.

CONCEPT: Each function box has its own number identifying it in the sequence of decomposition.

NARRATION: "IN THIS EXAMPLE A-0 REPRESENTS THE TOP LEVEL. ALL OTHER LEVELS ARE DECOMPOSITIONS OF SUBSEQUENT LEVELS AND ALWAYS PROCEED FROM MORE GENERAL TO A MORE DETAILED LEVEL OF DECOMPOSITION."

AUTHORING PROCEDURES	PROCESS
-------------------------	---------

- DEFINE CONTEXT, VIEWPOINT AND PURPOSE
- BOUND THE CONTEXT
- COLLECT DATA
- LIST DATA AND FUNCTIONS
- CLUSTER DATA AND FUNCTIONS
- SKETCH DATA AND ARROWS (LAYOUT)
- REFINE LAYOUT
- CONSTRUCT FIG'S, TEXT, AND GLOSSARY WHERE NEEDED

59-1 34

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the process involved in IDEF0 function modeling.

PROCEDURE: (Follow steps outlined on chart.)

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture-Part II, Volume IV - Function Modeling Manual (IDEF0)

SEE: "Authoring Process," Section 6 (A11)

NARRATION: "THE AUTHORING PROCESS ENTAILS FOLLOWING THE SPECIFIED AUTHORING PROCEDURES OUTLINED ON THIS CHART."

(TALK TO CHART)

**AUTHORING  
PROCEDURES | ORIENTATION OF MODELS**

---

**DEFINITIONS:**

- CONTEXT (SUBJECT)  
THE SCOPE OR BOUNDARIES OF THE  
SUBJECT MATTER
- VIEWPOINT (BIAS)  
THE PERSPECTIVE FROM WHICH A  
SUBJECT IS ANALYZED
- PURPOSE (OBJECTIVE)  
THE REASONS A MODEL IS CREATED  
THE WAYS THAT IT COULD BE USED

89-2 38

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the sequence and orientation of models.

PROCEDURE: Orientation of models includes defining context, viewpoint, and purpose.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER  
AIDED MANUFACTURING (ICAM), Architecture-Part II, Volume IV - Function  
Modeling Manual (IDEF3)

SEE: "Orientation of Models," Section 6  
(A11)

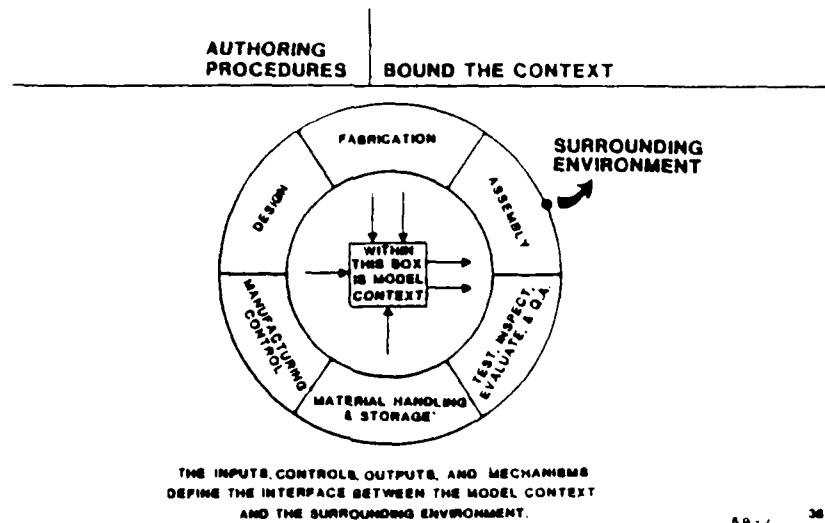
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NARRATION: (TALK TO CHART)

"THE CONTEXT, OR SUBJECT IS THE SCOPE, OR BOUNDARIES  
OF THE SUBJECT MATTER BEING MODELED."

"THE VIEWPOINT, OR BIAS IS THE PERSPECTIVE FROM WHICH  
A SUBJECT IS ANALYZED."

"THE PURPOSE, OR OBJECTIVE IS THE REASON OR REASONS  
WHY THE FUNCTION MODEL IS CREATED. THAT IS, THE WAYS  
THAT THE FUNCTION MODEL COULD BE USED."



INSTRUCTIONAL OBJECTIVE: To teach an understanding of the "context" information into which every IDEF<sub>0</sub> function model fits.

PROCEDURE: Decide context (subject) definition from surrounding environment.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture-Part II, Volume IV - Function Modeling Manual (IDEF<sub>0</sub>)

SEE: "Bound the Context," Section 6 (A11)

-----

NARRATION: "MODEL CONTEXT DEPENDS ON THE DEFINED PURPOSE OF THE FUNCTION MODEL AND THE WAYS IN WHICH THE FUNCTION MODEL INPUTS, CONTROLS, OUTPUTS, AND MECHANISMS INTERFACE WITH THE SURROUNDING ENVIRONMENT."

AUTHORING PROCEDURES	DATA COLLECTION
-------------------------	-----------------

HOW

- READ RELEVANT REFERENCE MATERIAL
- INTERVIEW EXPERTS
- OBSERVE THE SYSTEM IN PROGRESS

80-4 37

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedure of collecting data for IDEF<sub>0</sub> modeling.

PROCEDURE:                   1) Read relevant reference material  
                              2) Interview experts  
                              3) Observe the system in progress

REFERENCE:                   AFWAL-TR-81-4023/INTEGRATED COMPUTER  
                              AIDED MANUFACTURING (ICAM), Architecture-Part II, Volume IV - Function Modeling Manual (IDEF<sub>0</sub>)

SEE:                         "Data Collection," Section 7 (All)

-----  
NARPTION: "DATA COLLECTION INVOLVES READING RELEVANT REFERENCE MATERIAL, SUCH AS ORGANIZATIONAL CHARTS, INTERVIEWING EXPERTS, AS WELL AS, OBSERVING THE SYSTEM IN PROGRESS."

---

**AUTHORING  
PROCEDURES**

**DATA COLLECTION**

---

**WHAT:**

- **DEFINITIONS**
- **FUNCTIONS**
- **DATA**

89-2 38

**INSTRUCTIONAL OBJECTIVE:** To teach an understanding of what kind of data to collect for IDEF0 modeling.

**PROCEDURE:** Collect definitions of terms. Collect names of functions and subfunctions being modeled and collect data involved with functions and subfunctions being modeled.

-----  
**NARRATION:** "DATA COLLECTION IS GATHERING DEFINITIONS OF TERMS, FUNCTIONS, AND DATA."

## LIST DATA AND FUNCTIONS

80 - 30

INSTRUCTIONAL OBJECTIVE: To teach an understanding of how to list data and functions.

PROCEDURE: List data and functions.

NARRATION: "LISTING DATA AND FUNCTIONS IS ORGANIZING THE DATA COLLECTION GATHERED FROM READING RELEVANT REFERENCE MATERIAL, INTERVIEWING EXPERTS, AND OBSERVING THE SYSTEM IN PROGRESS."

## CLUSTER DATA AND FUNCTIONS



INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedure used for gathering data used in IDEF0 function modeling.

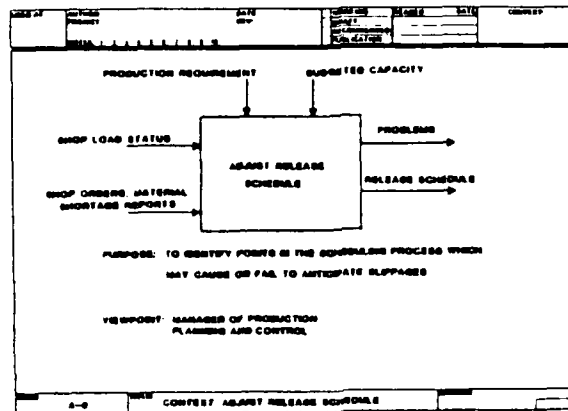
PROCEDURE: Cluster data and functions.

NARRATION: "CLUSTER DATA INTO INPUT DATA, CONTROL DATA, AND OUTPUT DATA."

"CLUSTER SUBFUNCTIONS INTO RESPECTIVE FUNCTION CATEGORIES."



AUTHORING  
PROCEDURES A-O DIAGRAM



59-2 41

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedure for diagramming the information in the A-O level (the whole function).

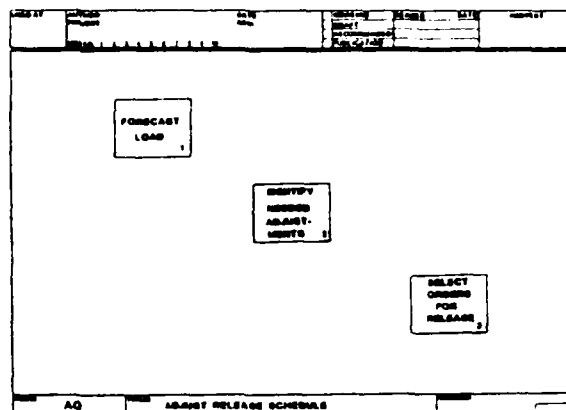
PROCEDURE: Organize data and functions into diagram form according to IDEF0 function model methodology.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture, Part II, Volume IV - Function Modeling Manual (IDEF0)

SEE: "A-O Diagram," Section 6, #6.1.2, Pg. 85

NARRATION: "THE A-O LEVEL DIAGRAM REPRESENTS THE WHOLE FUNCTION BEING MODELED COMPLETE WITH ITS INPUT, CONTROLS, OUTPUTS, AND MECHANISMS (NOT SHOWN ON THIS DIAGRAM). CAN ANYONE NAME SOME MECHANISMS BY WHICH THE ADJUST RELEASE SCHEDULE FUNCTION IS ACCOMPLISHED?"

AUTHORING  
PROCEDURES LAY OUT DIAGRAM



80-2 42

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedure for laying out the AO diagram (the next lower level of subfunctions involved in the whole system).

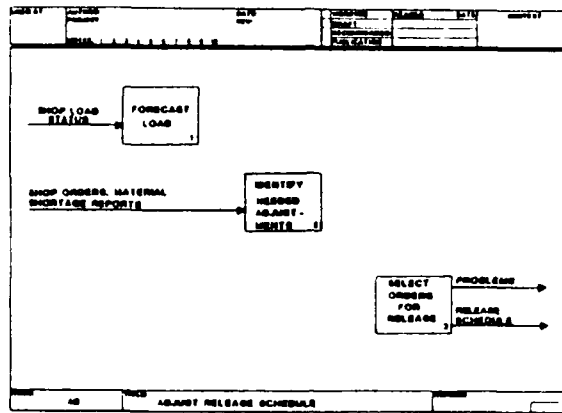
PROCEDURE: Determine next lower level of subfunctions involved in the whole function being modeled and lay out the function boxes from left to right.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture, Part II, Volume IV - Function Modeling Manual (IDEF0)

SEE: "Generate Function Boxes," Section 6, #6.2.1, Pg. 90

NARRATION: "FROM THE INFORMATION GATHERED ABOUT THE FUNCTION BEING MODELED DETERMINE NEXT LOWER LEVEL OF SUBFUNCTIONS, AND ARRANGE THEM IN THEIR FUNCTION BOXES FROM TOP LEFT TO LOWER RIGHT."

AUTHORING  
PROCEDURES LAY OUT DIAGRAM



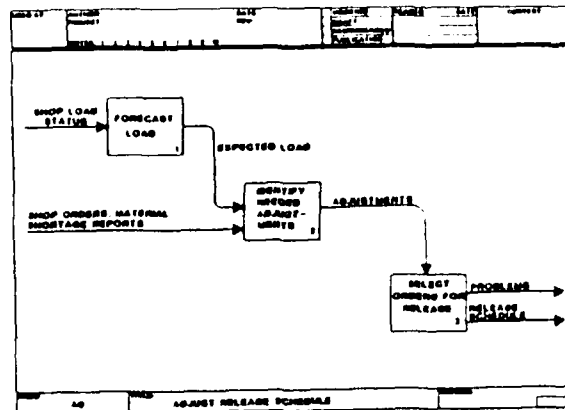
59-2 43

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedure for adding input data and output data to subfunctions of the AO level of decomposition.

PROCEDURE: Diagram inputs and outputs associated with their subfunctions.

NARRATION: "AFTER THE SUBFUNCTIONS HAVE BEEN LAID OUT, GO BACK TO THE DATA LIST THAT'S BEEN CLUSTERED AND ADD INPUTS AND OUTPUTS ASSOCIATED WITH THEIR RESPECTIVE SUBFUNCTIONS."

AUTHORING  
PROCEDURES LAY OUT DIAGRAM

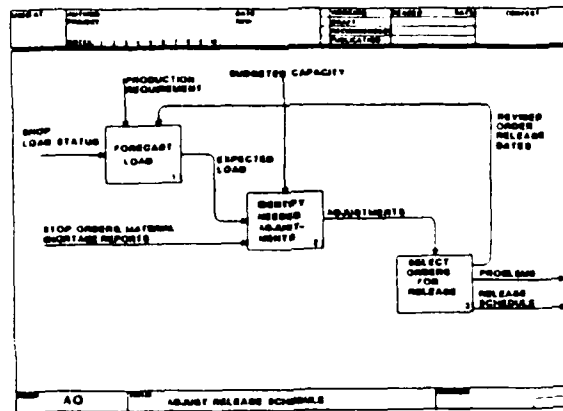


INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedures for adding output data to the subfunctions of the A0 level of decomposition.

PROCEDURE: Diagram controls from data list and cluster.

NARRATION: "NEXT, ADD ANY CONTROLS ASSOCIATED WITH THE SUBFUNCTIONS."

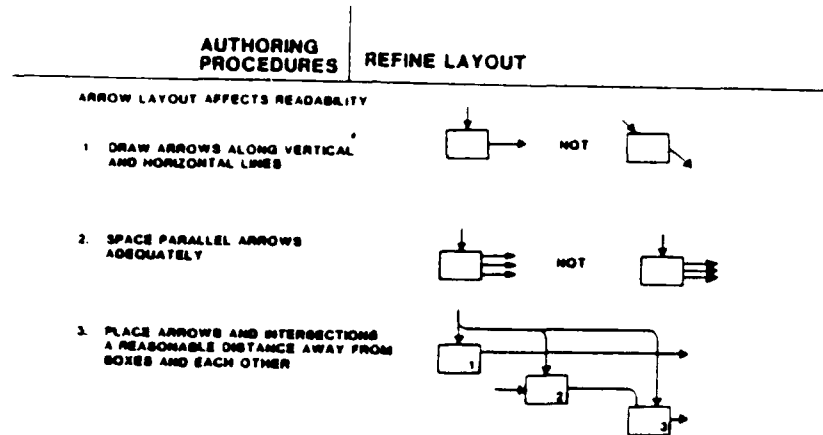
AUTHORING  
 PROCEDURES LAY OUT DIAGRAM



INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedures for adding feedback in the AO level of decomposition.

PROCEDURE: Diagram feedback output data arrow to control data.

NARRATION: "IN IDEF<sub>0</sub> MODELING, CHANGES OR REVISIONS TO THE FUNCTION BEING MODELED ARE ACCOMMODATED BY WAY OF FEEDBACK. FEEDBACK OUTPUT DATA ARROWS TO CONTROL DATA ALWAYS GO UP AND OVER."



59-2 48

INSTRUCTIONAL OBJECTIVE: To teach an understanding of how to diagram correctly with arrow notation in IDEF0 function modeling.

PROCEDURE: Follow "do's" and avoid "do not's" outlined in the following procedures for refining layout.

NARRATION: (TALK TO CHART)

AUTHORING PROCEDURES	REFINE LAYOUT
-------------------------	---------------

4. CONNECT OPEN-ENDED (PARENT) ARROWS TO SHOW ALL THE PLACES AFFECTED



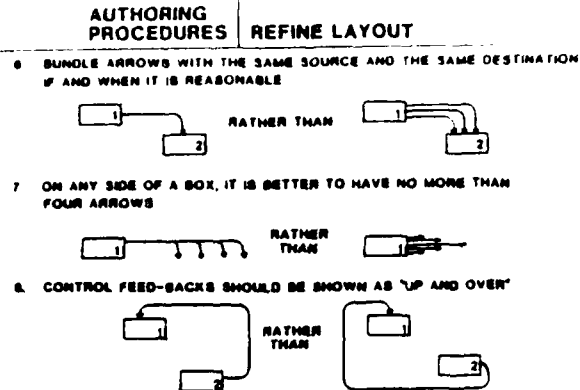
5. DON'T USE THE KEY WORDS (DATA, FUNCTION, OUTPUT, ETC) IN LABELING ARROWS AND BOXES

50-2 47

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedure for refining IDEF0 model diagram layout.

PROCEDURE: Follow "do's" and avoid "do not's" in placing data arrows in their respective function boxes.

-----  
NARRATION: (TALK TO CHART)



69-2 48

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedure for refining IDEF0 model diagram layout.

PROCEDURE: Follow "do's" and avoid "do not's" in order to simplify arrow notation for better communication.

NARRATION: (TALK TO CHART)



AUTHORING  
PROCEDURES

REFINE LAYOUT

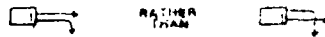
9 INPUT FEED-BACKS SHOULD BE SHOWN AS 'DOWN AND UNDER'



10 IF AN ARROW BRANCHES AND FEEDS INTO SEVERAL BOXES,  
DRAW IT AT THE SAME RELATIVE POSITION



11 DON'T CROSS ARROWS IF POSSIBLE

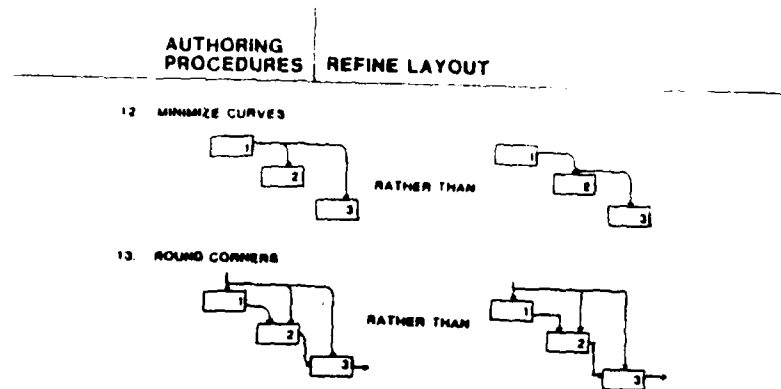


59-1 46

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedure for refining IDEF0 function model diagrams.

PROCEDURE: Follow "do's" and avoid "do not's" in order to simplify arrow notation for better communication.

NARRATION: (TALK TO CHART)



59-2 90

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedures used in refining an IDEF0 function model diagram layout.

PROCEDURE: Follow "do's" and avoid "do not's" in order to simplify arrow notation for better communication.

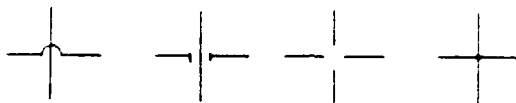
NARRATION: (TALK TO CHART)

AUTHORING PROCEDURES	REFINE LAYOUT
-------------------------	---------------

ALLOWED



NOT ALLOWED

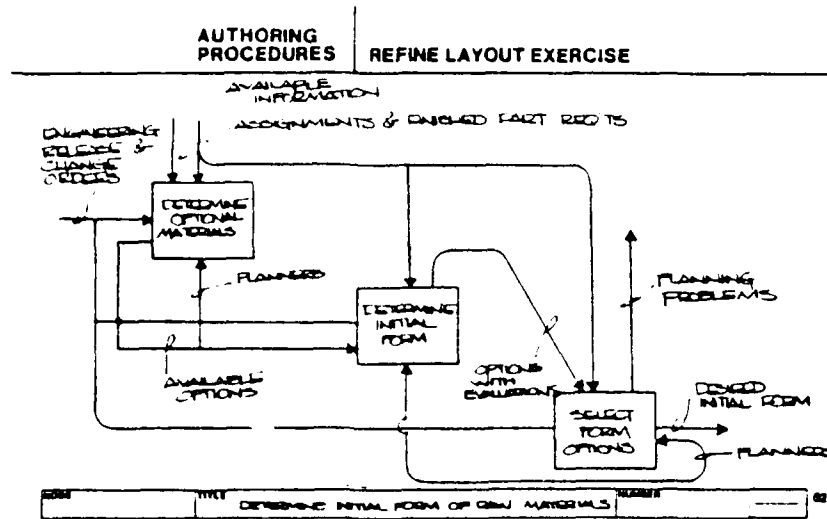


59 51

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedure for refining IDEF0 function model diagram layouts.

PROCEDURE: Follow allowed arrow notation and avoid arrow notation not allowed.

-----  
NARRATION: (TALK TO CHART)



INSTRUCTIONAL OBJECTIVE: To review standard arrow notation and function box layout in IDEF0 function modeling.

DIRECTIONS: HAVE PARTICIPANTS REFINE THIS LAYOUT ON THE FORM INCLUDED THE HANDOUTS ACCORDING TO THE PROCEDURES JUST COVERED IN THE PRECEDING LESSONS.

FTR110410000U  
8 September 1983

<b>AUTHORING PROCEDURES</b>	<b>REFINE LAYOUT EXERCISE</b>
---------------------------------	-------------------------------

[illegible]

50-2

INSTRUCTIONAL OBJECTIVE: To review refine layout procedures.

DIRECTIONS: USE THIS FORM TO REFINER THE LAYOUT ON THE PRECEDING REVIEW EXERCISE.

AUTHORING  
PROCEDURES FEO (FOR EXPOSITION ONLY)

A FEO:

- IS USED BY THE AUTHOR
  - TO ILLUSTRATE A POINT
  - TO CLARIFY A DIAGRAM
- IS A DIAGRAM THAT FALLS OUTSIDE THE STRICT HIERARCHY
- MAY CONTAIN MORE THAN SIX BOXES AND HAVE PARTIAL ARROW STRUCTURE (i.e. VIOLATE IDEF<sub>0</sub> (FUNCTION MODEL) SYNTAX
- MAY USE OTHER METHODOLOGIES (i.e. PERT, CPM, etc.

89 - 04

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the function and use of a F.E.O. Diagram.

PROCEDURE: Produce a F.E.O. for any IDEF<sub>0</sub> function model that requires clarification.

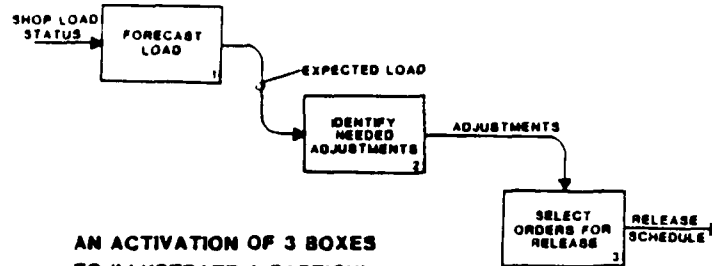
REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture, Part II, Volume IV - Function Modeling Manual (IDEF<sub>0</sub>)

SEE: "Creating Supporting Materials," Section 6, #6.1.5, Pg. 87

NARRATION: "A F.E.O. IS A SPECIAL KIND OF IDEF<sub>0</sub> FUNCTION MODEL DIAGRAM, USED: FOR EXPOSITION ONLY."

(TALK TO CHART)

**AUTHORING  
PROCEDURES** | **FEO (FOR EXPOSITION ONLY) EXAMPLE**



**AN ACTIVATION OF 3 BOXES  
TO ILLUSTRATE A PARTICULAR  
SCENARIO.**

50-2 50

**INSTRUCTIONAL OBJECTIVE:** F.E.O. (continued) to give a manufacturing example of a F.E.O.

**PROCEDURE:** Produce a F.E.O. for any IDEF<sub>0</sub> function model that requires clarification.

**REFERENCE:** AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture, Part II, Volume IV - Function Modeling Manual (IDEF<sub>0</sub>)

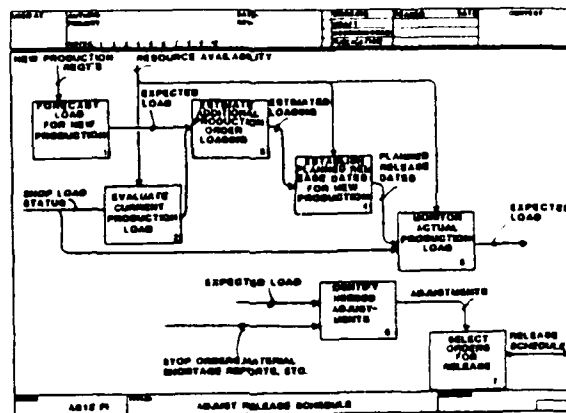
**SEE:** "Creating Supporting Materials," Section 6, #6.1.5, Pg. 87

**NARRATION:** "THIS IS AN EXAMPLE OF A F.E.O. IN A MANUFACTURING CONTEXT.

"THIS F.E.O. DIAGRAM HAS ONLY A PARTIAL ARROW STRUCTURE USED TO ILLUSTRATE CERTAIN INPUTS, CONTROLS, AND OUTPUTS OF A PARTICULAR FUNCTION THAT THE AUTHOR WISHES TO CLARIFY."

(TALK TO CHART)

AUTHORING  
PROCEDURES FEO (FOR EXPOSITION ONLY) EXAMPLE



89-2 56

INSTRUCTIONAL OBJECTIVE: F.E.O. (continued) to give a manufacturing example of a F.E.O.

PROCEDURE: Produce a F.E.O. for any IDEF0 function model that requires clarification.

NARRATION: "THIS IS ANOTHER EXAMPLE IN A MANUFACTURING CONTEXT."

(TALK TO CHART)



AUTHORING  
PROCEDURES TEXT

TEST	NAME	DATE	TIME	SCORE	REMARKS
1.1.1					
A010 P1 - IS A PEO (FOR EXPOSITION ONLY) DIAGRAM REPRESENTING A CLASSIFICATION VIEW OF DIAGRAM A010. ADJUST RELEASE SCHEDULE. THE A010 PEO SHOWS AN EXPANDED VIEW OF ADJUST RELEASE SCHEDULE FOR READER'S CLARIFICATION.					
A010 P1 - SHOWS THE STEPS INVOLVED IN ADJUSTING THE SHOP LOAD FOR ACTUAL CONDITIONS. BASED ON THE PRODUCTION REQUIREMENTS AND EXISTING LOAD, A FORECASTED LOAD IS DETERMINED ON THE SHOP TO MEET THE NEW PRODUCTION REQUIREMENTS.					
THESE ADJUSTMENTS TAKE THE FORM OF REVERSE SCHEDULING IN THE SHOP DUE TO SHIFTS OF THE LOAD DATES, SHOP ORDERING AND MATERIAL SHORTAGES.					
A010 P1					

59-2 57

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the func-  
tion and use of "text" in IDEF<sub>0</sub>  
function modeling.

PROCEDURE: Produce a text for a diagram that gives  
a brief overview of the diagram.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER  
AIDED MANUFACTURING (ICAM), Architec-  
ture, Part II, Volume IV - Function  
Modeling Manual (IDEF<sub>0</sub>)

SEE: "Creating Supporting Materials," Sec-  
tion 6, #6.1.5, Pg. 87

NARRATION: "ANY TEXT THAT ACCOMPANIES A DIAGRAM IS BRIEF, LESS  
THAN ONE PAGE IN LENGTH, AND PRESENTS AN OVERVIEW OF  
THE IDEF<sub>0</sub> FUNCTION BEING MODELED.

"THE PURPOSE OF THE TEXT IS FOR CLARIFICATION AND IS  
INTENDED TO FILL IN ANY MISSING INFORMATION NOT COM-  
MUNICATED BY THE IDEF<sub>0</sub> MODEL DIAGRAM."

AUTHORING  
PROCEDURES GLOSSARY

TERM	DEFINITION
<b>GLOSSARY</b>	
<b>EXPECTED LOAD</b>	LOAD AS FORECASTED FOR NEW PRODUCTION
<b>ADJUSTED LOAD</b>	ADJUSTED LOAD FOR ACTUAL NEW PRODUCTION LOAD CONDITION
<b>MATERIAL SHORTAGE</b>	REPORT CONSISTS OF NEW PRODUCTION REPORTS - LOT EFFICIENCY AND WORK BREAKDOWN STRESS PULSE IMPACT FOR SHORTAGE ITEMS
<b>REQUIRED AVAILABILITY</b>	REPORTED - MACHINE, EQUIPMENT, AND/OR PROCESS AVAILABILITY
<b>ESTIMATED LOADING</b>	THE ESTIMATE OF SHOP LOAD CONDITIONS FOR NEW PRODUCTION ORDER LOADING
<b>PLANNED RELEASE DATES</b>	DATES PLANNED FOR RELEASE OF NEW PRODUCTION ORDERS BASED ON CURRENT PRODUCTION LOAD AND FORECASTED LOAD REQUIREMENTS
<b>SHOP LOAD STATUS</b>	CURRENT AVAILABILITY OF SHOP LOAD
<b>RELEASE SCHEDULES</b>	SCHEDULES FOR RELEASE ORDERS FOR NEW PRODUCTION
<b>NEW PRODUCTION REQUIREMENTS</b>	REQUIREMENTS FOR MACHINERY, MATERIALS, EQUIPMENT, PROCESSES FOR NEW PRODUCTION
AD 107101	ADJUST RELEASE SCHEDULE GLOSSARY

5-1-2 58

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the function and use of the glossary to IDEF<sub>0</sub> function modeling.

PROCEDURE: List all terms that require clarification of definition.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture, Part II, Volume IV - Function Modeling Manual (IDEF<sub>0</sub>)

SEE: "Creating Supporting Materials," Section 6, #6.1.5, Pg. 87

NARRATION: "THE PURPOSE OF THE GLOSSARY IS TO DEFINE TERMS AS THEY ARE USED IN ANY SPECIFIC IDEF<sub>0</sub> FUNCTION MODELING CONTEXT."

AUTHORING PROCEDURES	DECOMPOSITION
-------------------------	---------------

- AUTHOR A DIAGRAM
- VERIFY AND REFIN
- DECOMPOSE AND ITERATE

59-4 00

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedure in decomposing an IDEF<sub>0</sub> function model.

PROCEDURE:

- 1) Author the specific level of the IDEF<sub>0</sub> function model.
- 2) Verify and refine that level of the IDEF<sub>0</sub> function model.
- 3) Decompose and iterate the IDEF<sub>0</sub> function model.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture, Part II, Volume IV - Function Modeling Manual (IDEF<sub>0</sub>)

SEE: "Author Activities," Section 6, #6.1.7, Pg. 88

NARRATION: (TALK TO CHART)

"THE FIRST STEP IN IDEF<sub>0</sub> AUTHORING PROCEDURES IS TO AUTHOR A DIAGRAM, THEN TO THINK ABOUT, VERIFY, AND REFIN THE DIAGRAM IN ORDER TO COMMUNICATE THE INTENDED MESSAGE, AND FINALLY TO DECOMPOSE THE A-0 LEVEL AND ITERATE THE IDEF<sub>0</sub> FUNCTION MODEL BY THE KIT OR MEETING PROCESS."

AUTHORING PROCEDURES	DECOMPOSITION PROCESS
-------------------------	-----------------------

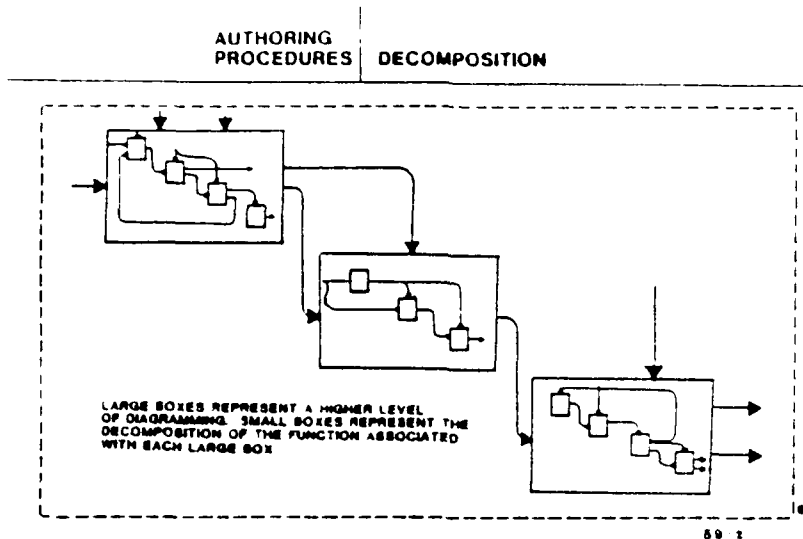
- CHOOSE BOX FOR DECOMPOSITION
- COLLECT DATA
- SOUND CONTEXT
- CLUSTER DATA AND FUNCTIONS
- SKETCH BOXES AND ARROWS (LAY OUT DIAGRAM)
- REFINE LAYOUT
- CONFIRM INTERFACE WITH PARENT
- SEND OUT KIT FOR REVIEW (VERIFY)

88-1 60

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedures for the decomposition process of IDEF<sub>0</sub> function modeling.

PROCEDURE: (As outlined on chart)

-----  
NARRATION: (FOLLOW THE STEPS OUTLINED ON THE CHART)



**INSTRUCTIONAL OBJECTIVE:** To teach an understanding of the procedures used in decomposing an IDEF<sub>0</sub> function model.

**PROCEDURE:** Start with A-0 level (the whole function) and break the A-0 level into its subfunctions.

-----

**NARRATION:** (TALK TO CHART)

## DECOMPOSITION

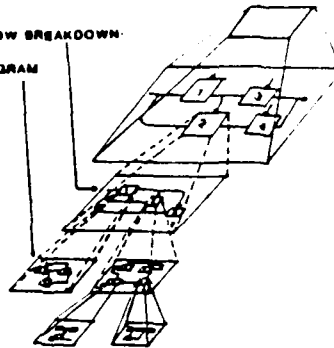
NUMBERED BOXES SHOW BREAKDOWN  
OF SINGLE BOX  
IN MORE GENERAL DIAGRAM

**MORE GENERAL**

↑

↓

**MORE DETAILED**

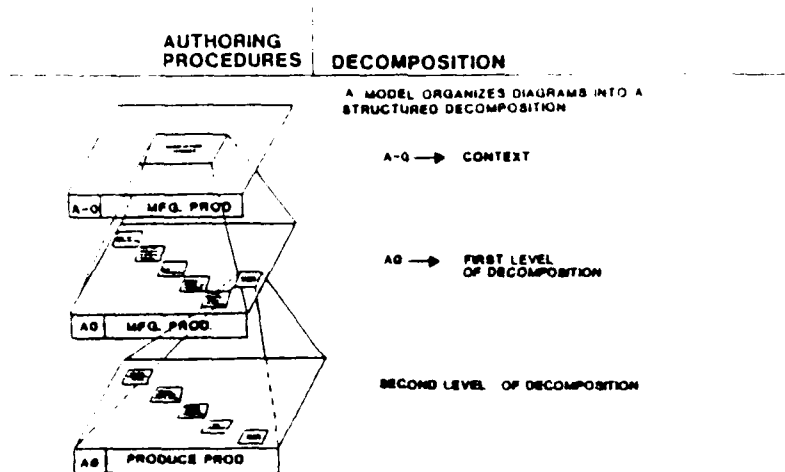


69-2 62

INSTRUCTIONAL OBJECTIVE: To teach an understanding of authoring decomposition procedures.

PROCEDURE: Decompose functions from a more general level to a more detailed level of decomposition.

NARRATION: "ALL DECOMPOSITIONS PROCEED FROM THE A-0 LEVEL TO NEXT LOWER LEVELS OF DETAIL."



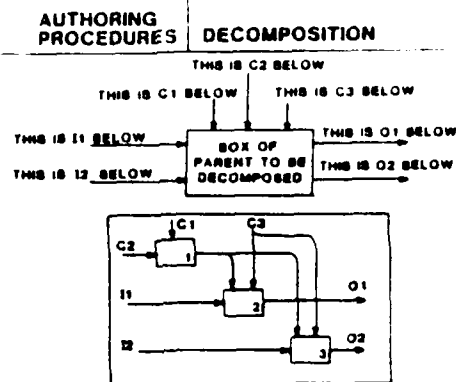
89-2 83

**INSTRUCTIONAL OBJECTIVE:** To teach an understanding of authoring decomposition procedures.

**PROCEDURE:** Proceed from the A-0 context to the first level of decomposition, and then to the second level of decomposition.

**NARRATION:** "THIS IS AN EXAMPLE OF THE DECOMPOSITION PROCESS IN A MANUFACTURING ENVIRONMENT."

(TALK TO CHART)



50-2 64

INSTRUCTIONAL OBJECTIVE: To teach an understanding of authoring decomposition procedures.

PROCEDURE: Keep track of ICOM notation throughout the decomposition process.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture, Part II, Volume IV - Function Modeling Manual (IDEFO)

SEE: "Coding Boundary Arrows" Section 3, #3.2.3, Pg. 37

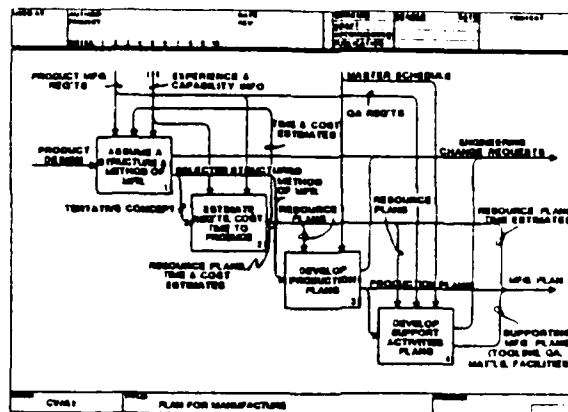
NARRATION: (TALK TO CHART)

"REMEMBER THE ICOM CODES:

I = INPUT  
C = CONTROL  
O = OUTPUT  
M = MECHANISM"



# AUTHORING PROCEDURES DECOMPOSITION



88  
59

INSTRUCTIONAL OBJECTIVE: To teach an understanding of authoring decomposition procedures by using a manufacturing example.

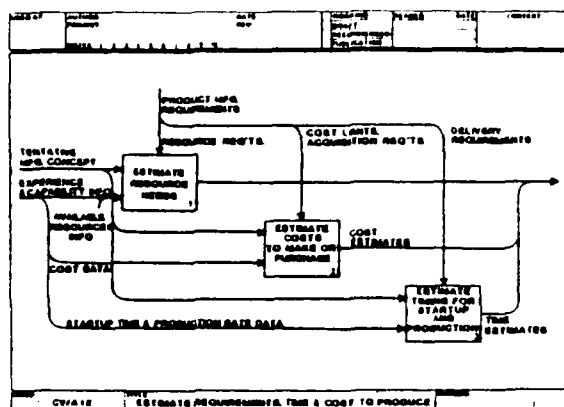
PROCEDURE: Keep track of ICOM notation throughout the decomposition process by using ICOM codes.

NARRATION: "THIS IS A MANUFACTURING EXAMPLE OF HOW THE USE OF ICOM CODES ARE USED TO HELP CLARIFY THE UNDERSTANDING OF THE IDEF0 FUNCTION MODEL THROUGHOUT THE DECOMPOSITION PROCESS.

"MECHANISMS ARE NOT FREQUENTLY SHOWN IN GENERIC MODELS BECAUSE THIS IS WHERE THE DIFFERENCES OCCUR AMONG AEROSPACE MANUFACTURERS.

"BUT, THE MECHANISMS ARE USUALLY SHOWN IN THE LOWEST LEVEL OF DECOMPOSITION."

# AUTHORING PROCEDURES DECOMPOSITION

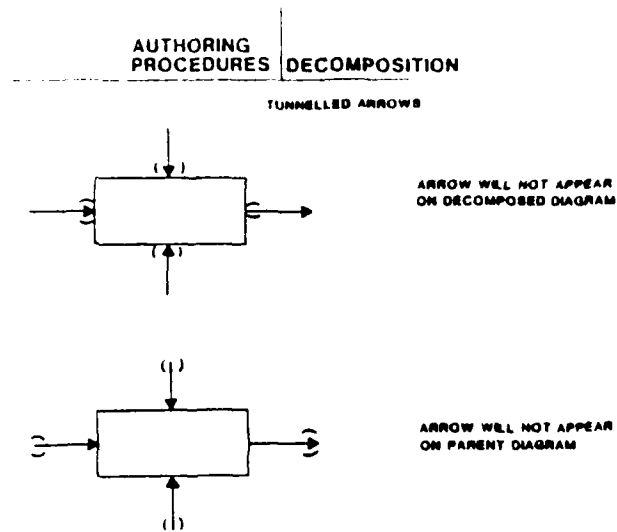


50-2 00

INSTRUCTIONAL OBJECTIVE: To teach an understanding of authoring decomposition procedures by using a manufacturing example.

PROCEDURE: Keep track of the ICOM notation throughout the decomposition process by using ICOM codes.

NARRATION: "THIS IS A FURTHER MANUFACTURING EXAMPLE OF HOW THE USE OF ICOM CODES ARE USED TO HELP CLARIFY THE UNDERSTANDING OF THE IDEF0 FUNCTION MODEL THROUGHOUT THE DECOMPOSITION PROCESS."



SS-1 07

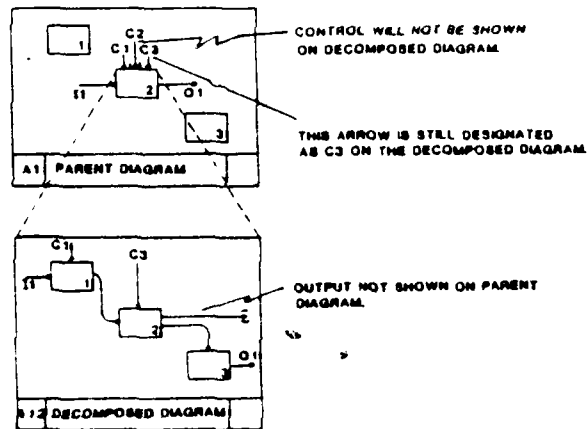
INSTRUCTIONAL OBJECTIVE: To teach an understanding of what happens to certain data in the decomposition process.

PROCEDURE: Tunnelled arrows are utilized to vary the data detail at the appropriate model level.

---

NARRATION: "SOMETIMES WE WANT TO SHOW AS MUCH DATA AS POSSIBLE ON THE HIGHEST LEVEL DIAGRAM. IF WE FIND THAT OUR PROJECT SCOPE IS NOT CONCERNED WITH ALL THE DATA WE HAVE INDICATED, WE HAVE A CONVENTION FOR SHOWING DATA AT HIGHER LEVELS AND DROPPING IT ALTOGETHER OR HAVING IT DISAPPEAR AND REAPPEAR LATER AT A LOWER LEVEL OF DECOMPOSITION."

# AUTHORING PROCEDURES | DECOMPOSITION



BB-2 68

INSTRUCTIONAL OBJECTIVE: To teach an understanding of authoring decomposition procedures.

PROCEDURE: Follow tunnelled arrow notation throughout the decomposition process.

NARRATION: (TALK TO CHART)

AUTHORING PROCEDURES		DIAGRAM FORM	
		DIAGRAM STATUS	PARENT CONTEXT
WORKING INFORMATION			
THE MESSAGE FIELD	AUTHOR AND PROJECT NAME		CREATION DATE AND REVISION DATE
	DIAGRAM TEXT		
	FEO		
	GLOSSARY		
IDENTIFICATION FIELD	MODEL NAME AND MODE NUMBER	TITLE OF MODE	C-NUMBER (NEW SOLD) PAGE NUMBER

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the diagram form used in IDEF<sub>0</sub> authoring procedures.

PROCEDURE: Fill in appropriate information in spaces provided.

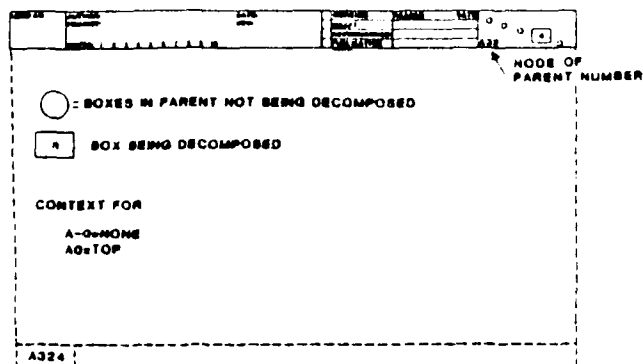
NARRATION: "DIAGRAM FORM PROVIDES:

- 1) STANDARDIZATION
- 2) CONSISTENCY

FOR COMMUNICATION."

AUTHORING  
PROCEDURES

CONTEXT ENTRY



89-1 70

INSTRUCTIONAL OBJECTIVE: To teach an understanding of context entry diagram form in IDEF0 authoring procedures.

PROCEDURE: Use standard IDEF0 form with context entry at top right hand corner of form.

NARRATION: (TALK TO CHART)

FTR1104100000  
8 September 1983

AUTHORING PROCEDURES	NODE NUMBER ENTRY
-------------------------	-------------------

COMPOSED OF

- MODEL NAME
- NUMBER OF SPECIFIC NODE

MODEL NAME	NUMBER OF SPECIFIC NODE
------------	-------------------------

IDENTIFIES TYPE OF PAGE

- DIAGRAM
- TEXT
- GLOSSARY
- PEO

IDENTIFIES TYPE OF PAGE	MODEL NAME	NUMBER OF SPECIFIC NODE
IDENTIFIES TYPE OF PAGE	MODEL NAME	NUMBER OF SPECIFIC NODE
IDENTIFIES TYPE OF PAGE	MODEL NAME	NUMBER OF SPECIFIC NODE

50-8 71

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the node number entry diagram form in IDEF0 authoring procedures.

PROCEDURE: Use standard IDEF0 form with node number entry under "node" section at lower left hand corner and "title" at lower center of diagram form.

NARRATION: (TALK TO CHART)





AUTHORING PROCEDURES	REFERENCE EXPRESSION
-------------------------	----------------------

TO FIND THE DETAILS OF A BOX, USE THE REFERENCE EXPRESSION TO IDENTIFY  
THE NODE NUMBER OF THE DECOMPOSED BOX.

REFERENCE EXPRESSION APPEARS

- OUTSIDE THE BOX
- BELOW THE BOX NUMBER



IF NO REFERENCE APPEARS, THE BOX HAS NOT YET BEEN DECOMPOSED.

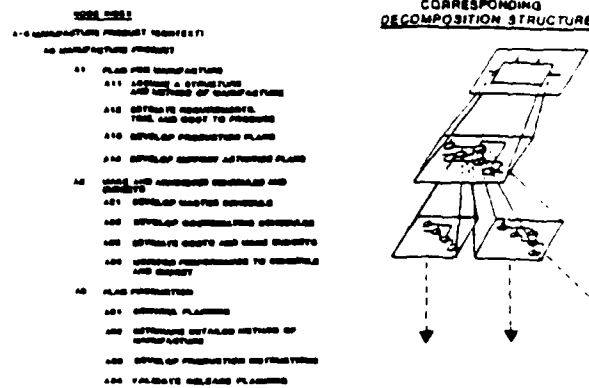
89-2 73

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the use of  
reference expression diagram form in  
IDEF<sub>0</sub> authoring procedures.

PROCEDURE: List reference expression to clarify  
the decompositions.

-----  
NARRATION: (TALK TO CHART)

AUTHORING  
PROCEDURES DOCUMENTATION- NODE INDEX



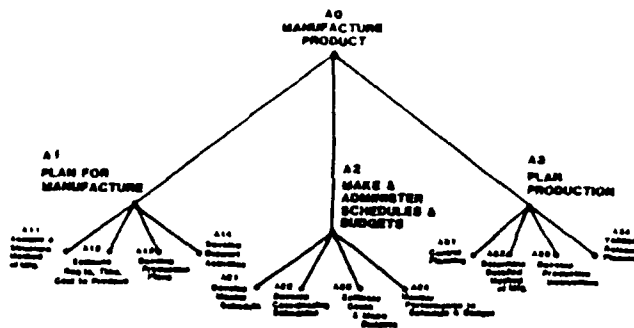
59-2 74

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the documentation node index used in IDEF0 function modeling.

PROCEDURE: Diagram the functions involved in the decomposition process in a list form according to node index.

NARRATION: (TALK TO CHART)

AUTHORING PROCEDURES | DOCUMENTATION - NODE TREE



50-8 78

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the documentation node tree used in IDEF0 function modeling.

PROCEDURE: Diagram the functions involved in the decomposition process in node tree form.

NARRATION: "THIS IS A MANUFACTURING EXAMPLE OF A NODE TREE USED TO DEVELOP AN UNDERSTANDING OF FUNCTION DECOMPOSITION IN IDEF0 FUNCTION MODELING."

**AUTHORING CONCEPTS  
AND PROCEDURES**

**AUTHORING EXERCISE**

BASED ON THE FOLLOWING MODEL PURPOSE AND VIEWPOINT, CREATE AN  
A-0 AND A0 DIAGRAM OF YOUR JOB

PURPOSE: TO UNDERSTAND AND COMMUNICATE THE FUNCTION OF MY JOB  
(PUT YOUR JOB IN PERSPECTIVE BY IDENTIFYING THE ORGANIZATION(S)  
YOU ARE PART OF.)

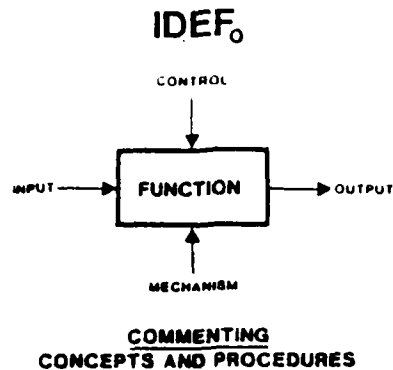
VIEWPOINT: "MYSELF" (STATE YOUR BACKGROUND AND EXPERIENCE)

89-1 78

INSTRUCTIONAL OBJECTIVE: To review the IDEF0 function modeling  
authoring concepts and procedures  
covered in this training manual.

-----  
DIRECTIONS: FOLLOW DIRECTIONS ON CHART USING IDEF0 DIAGRAM FORMS  
OR SCRATCH PAPER. WE WILL DISCUSS ANY PROBLEMS  
INFORMALLY.

NARRATION: "AFTER THE EXERCISE IS COMPLETED TELL THE PARTICI-  
PANTS THAT THIS EXERCISE HAS BEEN TO PROVOKE THOUGHT,  
TO PROVIDE PRACTICE, AND TO DEVELOP A BETTER UNDER-  
STANDING OF THE IDEF0 MODELING METHODOLOGY. THE  
MODELS WILL NOT BE COLLECTED OR DISPLAYED."



TITLE SLIDE: IDEF<sub>0</sub> Commenting Concepts and Procedures

COURSE OBJECTIVE: To teach an understanding of the commenting concepts and procedures involved in IDEF<sub>0</sub> function modeling.

NARRATION: "AN IDEF<sub>0</sub> FUNCTION MODEL GRAPHICALLY SHOWS OBJECTS AND/OR INFORMATION PERFORMED BY MEN AND/OR MACHINES THAT ENABLES YOU TO UNDERSTAND A SYSTEM.

"THIS SECTION OF OUR PROGRAM IS TO PROVIDE YOU WITH THE CONCEPTS AND PROCEDURES ESTABLISHED FOR IDEF<sub>0</sub> MODEL COMMENTING."

COMMENTING  
CONCEPTS &  
PROCEDURES | LEARNING OBJECTIVES

---

- 1 UNDERSTAND THE IMPORTANCE OF IDEF COMMENTING
- 2 UNDERSTAND THE IDEF KIT CYCLE
- 3 UNDERSTAND THE IDEF WALKTHROUGH MEETING PROCESS
- 4 UNDERSTAND THE IDEF LIBRARY FUNCTIONS

2-4 2

---

NARRATION: "COURSE LEARNING OBJECTIVES:

TO ENABLE YOU TO UNDERSTAND IDEF<sub>0</sub> FUNCTION MODELING,  
IN TERMS OF:

- 1) THE IMPORTANCE OF IDEF COMMENTING
- 2) THE IDEF KIT CYCLE
- 3) THE IDEF WALKTHROUGH MEETING PROCESS
- 4) THE IDEF LIBRARIAN FUNCTIONS"

COMMENTING  
CONCEPTS

COMMENTING

PRINCIPLES OF COMMENTING:

1. UNDERSTANDING: WHAT IS THE AUTHOR SAYING ?
2. AGREEMENT : DO I AGREE WITH THE AUTHOR?

50-1 3

INSTRUCTIONAL OBJECTIVE: To teach an understanding of commenting principles in developing IDEF<sub>0</sub> function models.

CONCEPT: Commenting includes understanding and agreement relative to IDEF<sub>0</sub> function models.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture, Part II, Volume IV - Function Modeling Manual (IDEF<sub>0</sub>)

SEE: "Commenter Guidelines," Section 5, #5.2.2.1, Pg. 65

NARRATION: "COMMENTING ON IDEF<sub>0</sub> FUNCTION MODEL DIAGRAMS INVOLVES AN UNDERSTANDING OF WHAT THE AUTHOR IS SAYING AND AN AGREEMENT WITH WHAT THE AUTHOR INTENDED TO SAY."

COMMENTING  
CONCEPTS

COMMUNICATION

## AUTHORING + COMMENTING = COMMUNICATION

89-1 4

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the role of communication in IDEF modeling.

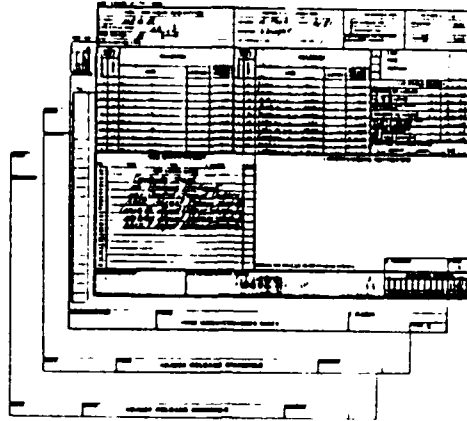
CONCEPT: Understanding and agreement equal communication.

-----  
NARRATION: "IDEF<sub>0</sub> MODELING METHODOLOGY PROVIDES A STANDARD FOR COMMUNICATION. THE READER MUST FIRST UNDERSTAND WHAT IS BEING SAID. UNDERSTANDING IS A MATTER OF KNOWING THE RULES OF IDEF<sub>0</sub> FUNCTION MODELING AND CROSS REFERENCING THE INFORMATION COMMUNICATED BY THE MODEL WITH THOSE RULES."



COMMENTING  
CONCEPTS

IDEF KIT



80-1 3

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the IDEF kit process.

CONCEPT: A standard of communication will provide a means for communicating in IDEF modeling.

NARRATION: "THE IDEF KIT CONCEPT PROVIDES STANDARD FORM FOR COMMUNICATION BY USING STANDARDIZED FORMS AND RULES AND PROCEDURES FOR DEVELOPING IDEF MODELS."

FTR1104100000  
8 September 1983

COMMENTING  
CONCEPTS

IDEF DIAGRAM COMMENTING PROCESS

ASPECTS TO LOOK FOR

- CLARITY
- CONSISTENCY
- CORRECT SYNTAX
- CORRECT SEMANTICS

50-1 6

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the IDEF diagram commenting process.

CONCEPT: There are specific aspects in the IDEF diagram commenting process that lead to communication.

-----  
NARRATION: "DECIDE:

- 1) DID THE AUTHOR GO BY THE RULES OF THE METHODOLOGY?
- 2) DO YOU AGREE WITH WHAT THE AUTHOR IS COMMUNICATING?"

COMMENTING PROCEDURES	IDEF DIAGRAM COMMENTING PROCESS
--------------------------	---------------------------------

MECHANICS

- (N) NOTES
- NOTE FIELD
- USE RED INK

ABOVE ALL — MAKE COMMENTS

- CLEAR
- BRIEF
- CONSTRUCTIVE

69-1 7

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedures involved in the IDEF diagram commenting process.

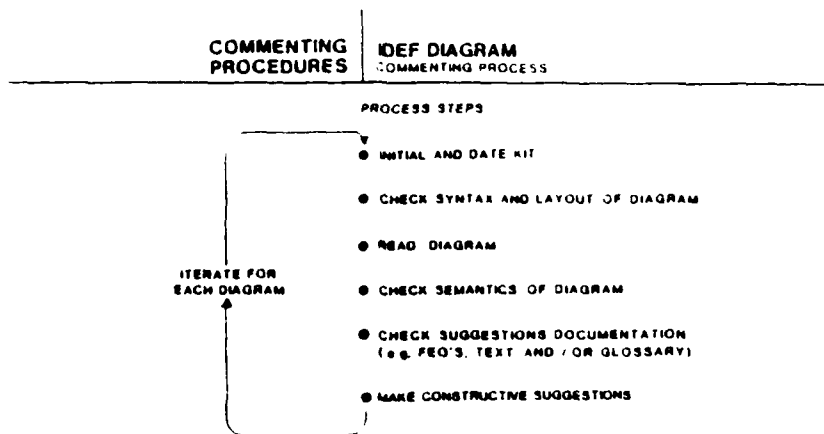
PROCEDURE: Make notes and use red ink.

-----  
NARRATION: "COMMENTING RULES ARE SIMPLE:

- o USE RED INK (REVIEWER)
- o NOTES
- o NOTE FIELD

MAKE COMMENTS:

- o CLEAR
- o BRIEF
- o CONSTRUCTIVE"



GV-3 8

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the procedures involved in the IDEF<sub>0</sub> diagram commenting process.

PROCEDURE: Follow the structured steps involved in the IDEF<sub>0</sub> diagram commenting process.

NARRATION: "FOLLOW THESE STEPS."  
(TALK TO CHART)

COMMENTING  
CONCEPTS

TEXT/GLOSSARY COMMENTING

TEXT/GLOSSARY SHOULD HAVE

- BREVITY
- STRUCTURE
- CLARITY

TEXT/GLOSSARY SHOULD BE WRITTEN

- TO CLARIFY INFORMATION  
CONVEYED BY THE DIAGRAM

59-4 9

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the role of text and glossary in the IDEF diagram commenting process.

CONCEPT: In order to clarify information conveyed by the IDEF diagram some attempt must be made to explain the background and terminology used in the IDEF model.

NARRATION: "IDEF TEST AND GLOSSARY ARE MEANT TO PROVIDE:

- 1) CLARIFY
  - 2) STRUCTURE
- TO THE IDEF<sub>0</sub> MODEL."

COMMENTING  
CONCEPTS

FEO COMMENTING

A FEO (FOR EXPOSITION ONLY)  
DON'T FORGET! A FEO

- IS ANY DIAGRAM THAT FALLS OUTSIDE THE STRICT HIERARCHY
- MAY CONTAIN MORE THAN SIX BOXES AND HAVE PARTIAL ARROW STRUCTURE
- IS USED BY THE AUTHOR
  - TO ILLUSTRATE A POINT
  - TO CLARIFY A DIAGRAM

A FEO ASKS:

- DO YOU UNDERSTAND ?
- DOES IT CLARIFY INFO FOR YOU ?
- DO YOU AGREE ?

50-1 10

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the role of a F.E.O. diagram in the IDEF modeling methodology.

CONCEPT: A F.E.O. provides background information to an IDEF0 function model diagram in addition to that provided by the text and glossary.

-----  
NARRATION: (TALK TO CHART)

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INTEGRATED COMPUTER-AIDED MANUFACTURING (ICAM)  
ARCHITECTURE PART 3 VOLUME (U) SOFTECH INC WALTHAM MA  
A W SNODGRASS SEP 83 1080-37

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F/G 13/8

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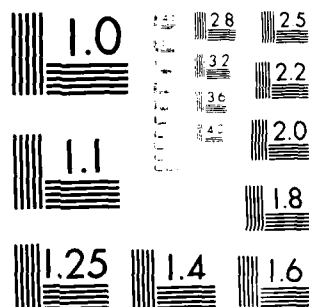
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DTIC



MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS-1963-A



COMMENTING  
CONCEPTS

APPROACHES TO COMMENTING

- IDEF KIT CYCLE
- IDEF WALKTHROUGH MEETING(S)

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the approaches used in the IDEF model diagram commenting process.

CONCEPT: IDEF commenting includes an interaction among understanding, agreement, and updating of IDEF model information.

-----  
NARRATION: "UNDERSTANDING, AGREEMENT, AND UPDATING OF IDEF0 FUNCTION MODELS INVOLVES:

- o THE IDEF KIT CYCLE
- o IDEF WALKTHROUGH MEETING(S)"

COMMENTING PROCEDURES	COMMENTING
--------------------------	------------

USING KIT CYCLE AND WALKTHROUGH MEETING(S)

- CIRCULATE KITS THROUGH KIT CYCLE
- AND / OR
- CONDUCT PERIODIC WALKTHROUGH MEETING(S)

89-J 12

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the commenting procedures used in the IDEF diagram commenting process.

PROCEDURE: Conduct IDEF kit cycle and/or conduct periodic walkthrough meeting(s).

-----

NARRATION: (TALK TO CHART)

COMMENTING PROCEDURES	COMMENTING
--------------------------	------------

KIT CYCLING ALTERNATIVES

- MAILING
- PERSONNEL MEETING

PRO'S AND CON'S

KIT CYCLE

- SAVES TRAVEL COSTS
- GOOD FOR INITIAL CONTACT
- SLOWER COMMENTING TURN-OVER TIME
- SLOWER TO GAIN CONSENSUS

WALKTHROUGH MEETING(S)

- QUICKER COMMENTING TURN-OVER TIME
- QUICKER TO GAIN CONSENSUS
- MORE TRAVEL COSTS
- GOOD FOR KIT FINALIZATION

59-3 13

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the commenting procedures used in the IDEF diagram commenting process.

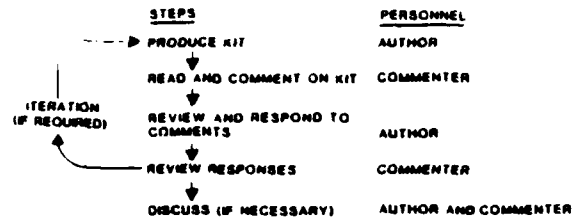
PROCEDURE:

- o Use kit cycling alternatives
- o Use IDEF kit cycle
- o Use IDEF walkthrough meeting(s)

-----

NARRATION: (TALK TO CHART)

COMMENTING CONCEPTS	IDEF KIT CYCLE STEPS AND PERSONNEL
------------------------	---------------------------------------



50-4 14

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the steps and personnel involved in the IDEF kit cycle.

CONCEPT: The IDEF kit cycle involves personnel and a structured set of steps to follow.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture, Part II, Volume IV - Function Modeling Manual (IDEF0)

SEE: "The IDEF Kit Cycle," Section 5, #5.2 (Figure 5-1), Pg. 62

NARRATION: (TALK TO CHART)

FTR1104100000  
8 September 1983

COMMENTING PROCEDURES	IDEF KIT CYCLE DISCUSSION
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DISCUSSION RULES

- ONLY IF NECESSARY
- DISCUSS POINTS OF DISAGREEMENT ONLY
- LIMIT TIME
- DECIDE ACTIONS
- RECORD RESULTS

SV-J 18

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the IDEF  
kit cycle discussion rules.

PROCEDURE: Follow IDEF kit cycle discussion rules.

-----  
NARRATION: (TALK TO CHART)

FTR110410000U  
8 September 1983

COMMENTING PROCEDURES	IDEF KIT CYCLE AUTHOR RESPONDING
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AUTHOR RESPONDS TO ALL COMMENTS

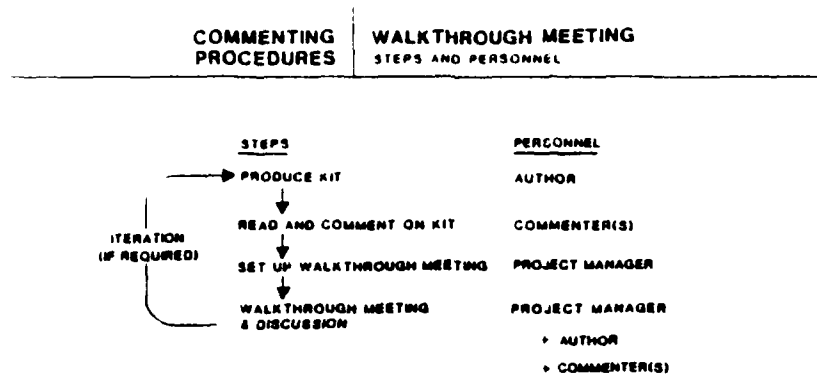
- UNDERSTAND COMMENTS
- "✓" IF AGREE
- "X" IF DISAGREE WITH EXPLANATION
- USE BLUE INK
- NOTE "LET'S TALK" - IF NECESSARY
- NOTE COMMENTS ON AUTHOR COPY
- RETURN KIT TO COMMENTER

20-3 16

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the conventions used in IDEF kit cycle author responding.

PROCEDURE: Use IDEF kit cycle notation in commenting on IDEF<sub>0</sub> function model diagrams.

-----  
NARRATION: (TALK TO CHART)



50-2 17

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the steps and personnel involved in the IDEF kit cycle walkthrough meeting.

PROCEDURE: Follow IDEF walkthrough meeting steps with involved personnel.

NARRATION: (TALK TO CHART)

FTR110410000U  
8 September 1983

COMMENTING PROCEDURES	IDEF DIAGRAM WALKTHROUGH PROCESS
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SIX STEPS

- 1 SCAN THE DIAGRAM
- 2 LOOK AT THE PARENT DIAGRAM
- 3 CONNECT THE PARENT BOX AND THE DETAIL DIAGRAM
- 4 EXAMINE THE INTERNAL ARROW PATTERN
- 5 READ THE TEXT AND GLOSSARY
- 6 SET THE STATUS OF THE DIAGRAM

SM-2 18

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the IDEF diagram walkthrough process.

PROCEDURE: Follow IDEF diagram six steps in carrying out the IDEF walkthrough process.

-----  
NARRATION: (TALK TO CHART)



FTR110410000U  
8 September 1983

COMMENTING PROCEDURES	IDEF KIT CYCLE ITERATION
--------------------------	-----------------------------

AUTHOR REFINES DIAGRAM AND ITERATES

- INCORPORATES NECESSARY CHANGES
- ISSUES SUBSEQUENT KIT
- COMMENTERS REFER TO PREVIOUS KIT TO EVALUATE CHANGES

50-1 19

INSTRUCTIONAL OBJECTIVE: To teach an understanding of IDEF kit cycle iteration.

PROCEDURE: Follow IDEF kit cycle iteration steps.

-----  
NARRATION: (TALK TO CHART)

COMMENTING  
CONCEPTS &  
PROCEDURES

LIBRARY FUNCTION

WHETHER YOU USE IDEF KIT CYCLE OR  
WALKTHROUGH MEETING PROCESS  
(OR BOTH)-

YOU MUST HAVE SOME LEVEL OF  
CONTROL FOR IDEF MODELING  
TO MANAGE THE COMMUNICATION PROCESS

89-J 20

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the librarian function in IDEF modeling.

CONCEPT: The librarian function in the IDEF modeling methodology maintains the necessary control of the IDEF<sub>0</sub> function model information.

PROCEDURE:

- o Maintains files
- o Controls distribution of documented information
- o Copies, distributes, and tracks IDEF information

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM), Architecture, Part II, Volume IV - Function Modeling Manual (IDEF<sub>0</sub>)

SEE: "The IDEF Kit Cycle," Section 5, #5.2 (Figure 5-1), Pg. 62

-----  
NARRATION: (TALK TO CHART)

COMMENTING  
PROCEDURES

IDEF KIT CYCLE  
LIBRARY FUNCTIONS

- MAINTAINS FILES
- CONTROLS DISTRIBUTION OF DOCUMENTED INFORMATION
- RECEIVES, COPIES, DISTRIBUTES, TRACKS AND TRANSFERS

59-J 21

INSTRUCTIONAL OBJECTIVE: To teach an understanding of the IDEF kit cycle librarian functions.

PROCEDURE: The librarian function:

- o Maintains files
- o Controls distribution of documented information
- o Copies, distributes, and tracks IDEF information

-----  
NARRATION: (TALK TO CHART)

COMMENTING  
CONCEPTS &  
PROCEDURES

COMMENTING EXERCISE

YOU PLAY THE ROLE OF A COMMENTER  
AND LOOK FOR

- SYNTAX ERRORS  
(IDEF SYMBOLS AND RULES)
- SEMANTIC ERRORS  
(MISUNDERSTANDINGS OF THE  
INTENDED AUTHOR COMMUNICATION)
- DISAGREEMENTS WITH THE AUTHOR  
(AFTER YOU UNDERSTAND WHAT  
AUTHOR INTENDED)

THEN NOTE YOUR COMMENTS ON THE DIAGRAM FOLLOWING  
THE GUIDELINES JUST PROVIDED

59-J 22

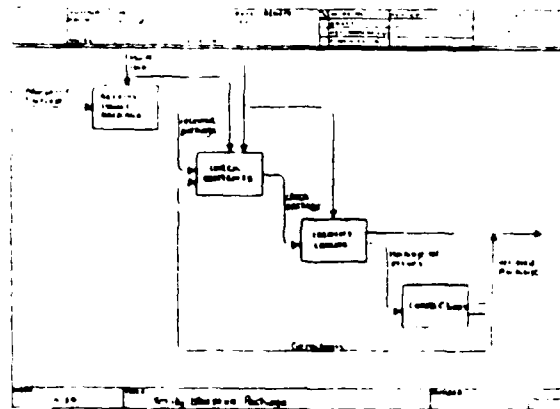
INSTRUCTIONAL OBJECTIVE: To give an exercise in IDEF0 commenting  
concepts to reinforce what has been  
taught.

-----  
DIRECTIONS: PLAY THIS COMMENTER ROLE IN THE FOLLOWING EXERCISE.

(TALK TO CHART)

COMMENTING  
CONCEPTS &  
PROCEDURES

IDEF KIT CYCLE  
COMMENTING EXERCISE



59-3

23

INSTRUCTIONAL OBJECTIVE: To give an exercise in IDEF kit cycle commenting concepts and procedures.

DIRECTIONS: COMMENT ON IDEF<sub>0</sub> FUNCTION MODEL DIAGRAM IN PRESENTATION HANDOUT MATERIALS ACCORDING TO THE STRUCTURED ROLE OF A COMMENTER.

# ARCHITECTURE

FTB110410000L  
9 September 1983



## A STRUCTURED APPROACH TO MANUFACTURING

TITLE SLIDE: Architecture - A Structured Approach to Manufacturing

COURSE OBJECTIVE: To teach an understanding of the ICAM generic manufacturing architecture (MFGO) and its utilization as a Manufacturing Technology Modernization (TECH MOD) planning and analytical tool.

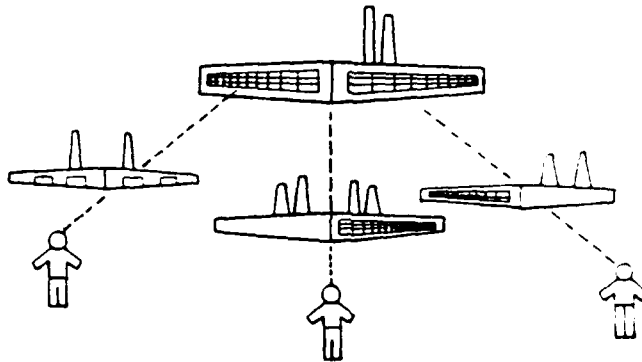
REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM) Architecture, Part II, Volume II - Architecture - A Structured Approach to Manufacturing

SEE: (ALL)

NARRATION: "TO IMPROVE PRODUCTIVITY, WE NEED (AMONG OTHER THINGS) A MEANS OF TRANSFORMING THE BLACK MAGIC OF MANUFACTURING TO A SCIENCE. EMBEDDED WITHIN MUST BE A COMMUNICATION STANDARD TO SERVE AS BOTH A TOOL FOR MANAGEMENT PLANNING AND CONTROL AND SYSTEM INTEGRATION. THE SUBJECT OF THIS PORTION OF OUR PRESENTATION, 'ARCHITECTURE - A STRUCTURED APPROACH TO MANUFACTURING' IS SUCH A MEANS. THE ARCHITECTURE IS FORMED BY A FUNCTION MODEL USING IDEF<sub>0</sub>, AN INFORMATION MODEL USING IDEF<sub>1</sub>, AND A DYNAMICS MODEL USING IDEF<sub>2</sub>. EACH MODEL IS AN ARCHITECTURE UNTO ITSELF - REPRESENTING A DISTINCT BUT RELATED VIEW OF A SUBJECT, I.E., MANUFACTURING. THIS PRESENTATION WILL ILLUSTRATE USES OF THE ARCHITECTURE SUCH AS A MANAGEMENT AND TECHNICAL TOOL AND AS WELL, AN EDUCATIONAL TOOL. IT IS INTENDED THAT THESE ILLUSTRATIONS WILL STIMULATE FURTHER USES OF ARCHITECTURE AS YOU CONSIDER YOUR PARTICULAR APPLICATIONS."

## STANDARD FOR COMMUNICATION

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59-1 2

INSTRUCTIONAL OBJECTIVE: To provide an understanding that the manufacturing architecture provides a standard for communication relative to complex systems and organizations.

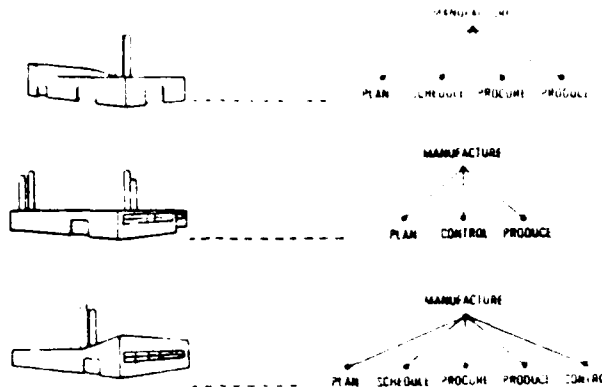
NARRATION: "MANUFACTURING IS A VERY COMPLEX ENVIRONMENT, I.E., MANY DISCIPLINES - PLANNING, QUALITY ASSURANCE, PRODUCTION, ETC.; MANY SYSTEMS - MANUFACTURING CONTROL, GENERATIVE PROCESS PLANNING, MRP, DNC, ETC. AND MANY TECHNOLOGIES - COMPUTERS, ROBOTICS, LASERS, ETC. BUT TO MAKE MATTERS MORE COMPLEX MANUFACTURING IS CARRIED OUT BY MANY PEOPLE RANGING FROM MANAGEMENT TO THE SHOP FLOOR WHICH ADDS TO THE COMPLEXITY BY ADDING MANY VIEWPOINTS BASED UPON EXPERIENCE, RESPONSIBILITY, AND PURPOSE.

"WE NEED A MEANS TO BETTER COMMUNICATE:

- 1) TO APPRECIATE EACH OTHERS VIEWPOINT
- 2) DEAL WITH ALL ASPECTS OF MANUFACTURING ON A COMMON BASIS WHETHER IT INVOLVES DISCIPLINES, SYSTEMS OR TECHNOLOGIES.

TO FACILITATE COMMUNICATION, THE MEANS MUST BE A COMMON STANDARD, I.E., ARCHITECTURE OR FRAMEWORK."

## STANDARD FOR COMMUNICATION



INSTRUCTIONAL OBJECTIVE: To provide an understanding that the manufacturing architecture provides a standard for communication relative to complex systems and organizations.

NARRATION: "TO FACILITATE EXPRESSING DIFFERING VIEWPOINTS, WE NEED A STRUCTURED METHOD OR TECHNIQUE THAT ESTABLISHES A STANDARD FOR COMMUNICATION - IDEF - TO CHARACTERIZE MANUFACTURING BASED ON FUNCTIONS - INFORMATION - DYNAMICS.

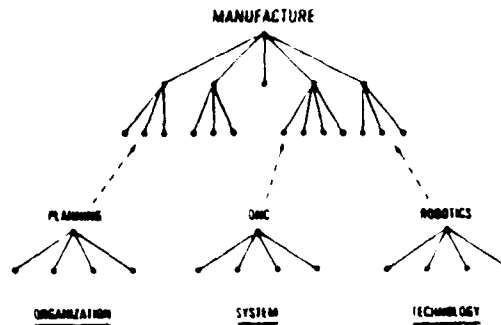
REGARDLESS OF ORIENTATION BASED UPON RESPONSIBILITY OR FUNCTION, EVERYONE'S VIEWPOINT CAN BE EXPRESSED IN A STRUCTURED REPRESENTATION. THIS WILL OVERCOME MISUNDERSTANDING CAUSED BY INTERPRETATION OF THE WRITTEN OR SPOKEN WORD AND EXPOSE MORE CLEARLY WHAT IS BEING COMMUNICATED.

THE STANDARD FOR COMMUNICATION MUST REVERSE 'THE COMPOUNDING EFFECT' OF DIFFERING VIEWPOINTS WHICH BECAUSE OF POOR COMMUNICATION MAY APPEAR TO BE OPPOSING OR CONFRONTING. THIS WILL PROVIDE A 'SYNERGISTIC EFFECT' BY ENABLING US TO STRUCTURE OUR COMMUNICATION AND EXPOSE MORE CLEARLY OUR PERSPECTIVE RESULTING IN A COLLECTIVELY ENHANCED UNDERSTANDING OF MANUFACTURING."



## STANDARD FOR COMMUNICATION

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50-4

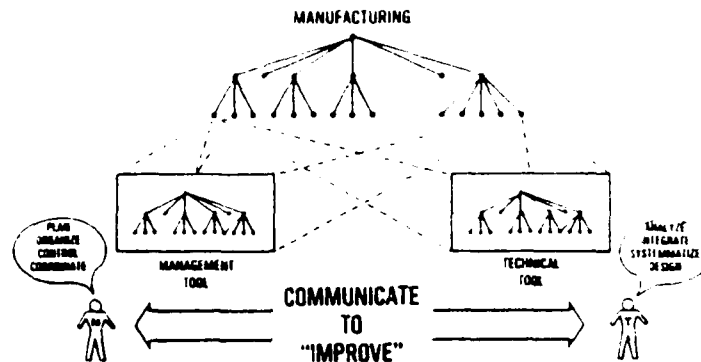
INSTRUCTIONAL OBJECTIVE: To provide an understanding that the manufacturing architecture provides a standard for communication relative to complex systems and organizations.

NARRATION: "WE NEED AN 'ARCHITECTURE' TO FACILITATE PUTTING VIEWPOINTS INTO PERSPECTIVE AND PROVIDE A COMMON BASIS UPON WHICH WE CAN DEAL WITH ALL ASPECTS OF MANUFACTURING, I.E., ORGANIZATION, SYSTEM, AND TECHNOLOGIES.

"THIS ARCHITECTURE MUST PROVIDE A FRAMEWORK, A ROAD MAP, A BLUEPRINT, A DICTIONARY FROM WHICH WE CAN DEPART FROM AND REFER BACK TO. THE KEY TO INCREASED MANUFACTURING PRODUCTIVITY IS TO DO IT SMARTER. TO DO IT SMARTER, WE MUST INTEGRATE AND TO INTEGRATE WE MUST BETTER UNDERSTAND HOW ALL THE 'PIECES' FIT TOGETHER. WE MUST UNDERSTAND BETTER OUR OWN DOMAIN AND HOW WE FIT INTO THE WHOLE.

"GIVEN THAT OUR OBJECTIVE IS IMPROVED MANUFACTURING PRODUCTIVITY, THE TASK WILL REQUIRE US TO INTEGRATE THE MANAGEMENT AND OPERATIONS OF MANUFACTURING. THIS MEANS NOT JUST TO INTEGRATE COMPUTERS TOGETHER BUT TO INTEGRATE WHAT COMPUTERS WILL ENABLE I.E., INTEGRATED ORGANIZATIONS, SYSTEMS, AND TECHNOLOGIES."

## USES OF ARCHITECTURE



INSTRUCTIONAL OBJECTIVE: To provide an understanding of how architecture utilization will result in improved communications.

NARRATION: "AN ARCHITECTURE OR FRAMEWORK CAN BE USED AS A MANAGEMENT TOOL AND AS A TECHNICAL TOOL. IT IS A MULTI-PURPOSE TOOL: MANAGEMENT IS CONCERNED WITH PLANNING, ORGANIZING, CONTROLLING, AND COORDINATING. THE TECHNICAL PEOPLE, WHO ARE CONSTRAINED BY MANAGEMENT, ARE CONCERNED WITH ANALYZING, INTEGRATING, SYSTEMATIZING, AND DESIGNING. BOTH MUST WORK TOGETHER TO IMPROVE MANUFACTURING AND COMMUNICATION IS IMPERATIVE.

"THEREFORE, THE TRUE CONTRIBUTION OF ARCHITECTURE IS THAT IT IS A MULTI-PURPOSE TOOL:

- o IT TRANSCENDS VIEWPOINT
- o IT TRANSCENDS SYSTEMS, TECHNOLOGIES, ORGANIZATIONS
- o IT IS A MANAGEMENT/TECHNICAL TOOL (MANAGE/OPERATE)
- o LAST BUT NOT LEAST, IT IS AN EDUCATIONAL TOOL

ARCHITECTURE IS A COMMON TOOL THAT EVERYONE CAN USE TO IMPROVE MANUFACTURING TOGETHER."

## MANAGEMENT TOOL

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- PRESENTATION MEDIUM
- ORGANIZATIONAL STRUCTURE
- PLANNING VEHICLE
- PROGRAM MANAGEMENT

50-1 8

INSTRUCTIONAL OBJECTIVE: To provide an understanding of how to use architecture as a management tool.

---

NARRATION: "AS A MANAGEMENT TOOL, AN ARCHITECTURE PROVIDES VISIBILITY INTO MANUFACTURING BY STRUCTURING A REPRESENTATION OF MANUFACTURING FUNCTIONS, INFORMATION, AND DYNAMICS.

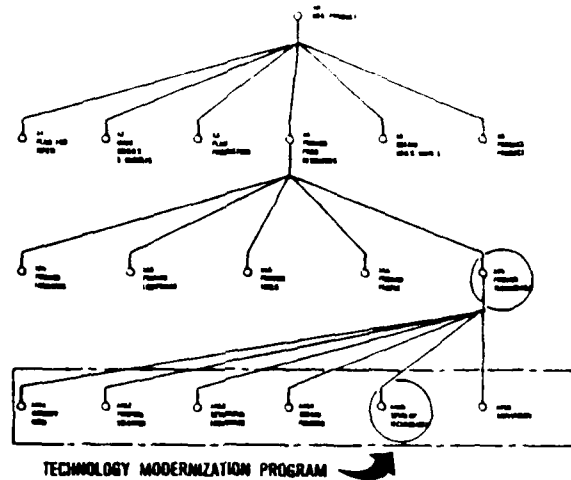
"IT IS AN EXCELLENT PRESENTATION MEDIUM FOR PROVIDING PERSPECTIVE AND FOCUS REGARDING THE SUBJECT OF THE PRESENTATION, I.E., GENERAL TO SPECIFIC 'ZOOM IN'.

"IT IS THE FRAMEWORK UPON WHICH AN ORGANIZATIONAL STRUCTURE/HIERARCHY BASED UPON RESPONSIBILITY CAN BE MORE EXPLICITLY DOCUMENTED, I.E., MAP ORGANIZATIONAL RESPONSIBILITIES TO FUNCTIONS, AND IDENTIFY OVERLAPS/VOIDS.

"IT IS A VEHICLE FOR PERFORMING PLANNING OF MULTI-YEAR CAD/CAM IMPROVEMENT. IT PROVIDES A FRAMEWORK FROM WHICH TO DEPICT CAD/CAM IMPROVEMENTS, ORGANIZATION RESTRUCTURING, AND THE LOGICAL PROGRESSION OF THE MULTI-YEAR IMPROVEMENT PROGRAM.

"LAST BUT NOT LEAST, IT IS AN EXCELLENT MEDIUM FOR ORGANIZING AND ADMINISTERING A CAD/CAM PROGRAM TO IMPLEMENT IMPROVEMENTS. THIS PROGRAM MANAGEMENT DEFINES ACTIVITIES, STRUCTURES THE PROGRAM, IDENTIFIES RESPONSIBILITIES, AND PROVIDES A FRAMEWORK FOR SUBSEQUENT PLANNING AND CONTROL."

## PRESENTATION MEDIUM



2-491 7

INSTRUCTIONAL OBJECTIVE: To provide an understanding of how architecture can be used as a presentation medium.

NARRATION: "THIS IS A FUNCTIONAL ARCHITECTURE NODE TREE EXAMPLE CREATED FROM THE IDEF<sub>0</sub> METHODOLOGY.

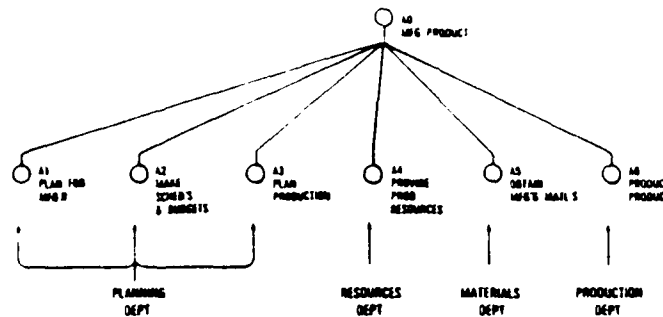
"THERE ARE OTHER REPRESENTATIONS, BUT NODE TREE IS MOST OFTEN USED. IT PROVIDES 'BIG PICTURE' OR ENVIRONMENT FROM WHICH ONE WANTS TO DRAW A PERSPECTIVE.

"FOR EXAMPLE: WHERE DOES A MANUFACTURING TECHNOLOGY MODERNIZATION PROGRAM OR CAD/CAM PROGRAM FIT INTO MANUFACTURING AS AN ORGANIZATION? WHAT FUNCTIONS DO THEY PERFORM?

"THIS CHART PORTRAYS AN APPROACH TO MODIFICATION OF THE GENERIC ARCHITECTURE TO ADD NODE A-45 WHICH PROVIDES TECHNOLOGY AND ITS SUBSEQUENT DECOMPOSITION AS SHOWN."

(TALK THROUGH A-45 NODE DECOMPOSITION)

## ORGANIZATIONAL STRUCTURE



50-1 8

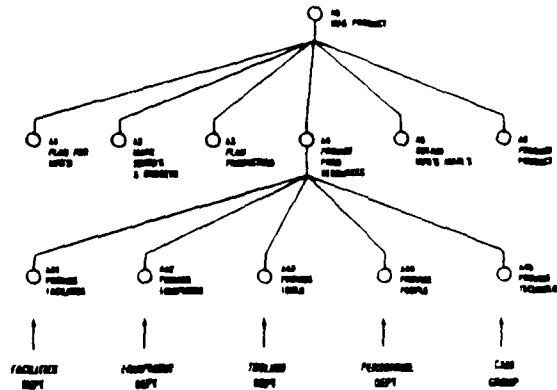
INSTRUCTIONAL OBJECTIVE: To provide an understanding of how architecture can be utilized in planning organizational structure and responsibilities.

NARRATION: "A NODE TREE REPRESENTATION IS MOST OFTEN USED AS A PRESENTATION MEDIUM OF ARCHITECTURE BECAUSE IT PROVIDES THE 'BIG PICTURE' OR 'ENVIRONMENT' FROM WHICH ONE WANTS TO DRAW A PERSPECTIVE. THE ANNOTATING OF THE ARCHITECTURE CAN BE TOP-DOWN OR ONE MAY CHOOSE A PARTICULAR LEVEL. THE IMPORTANT CONCEPT TO KEEP IN MIND IS THAT THE TOP-DOWN DECOMPOSITION OF THE FUNCTION ARCHITECTURE IS NOT A TRUE ORGANIZATIONAL HIERARCHY BUT MERELY A LEVEL-BY-LEVEL DETAIL EXPOSITION OF FUNCTION AND DATA.

"AFTER A COMPLETE ANNOTATION OF ALL MANUFACTURING ORGANIZATIONS, THERE IS A NEW PERSPECTIVE FROM WHICH TO VIEW THE FUNCTION ARCHITECTURE - IT NOW DEPICTS THE 'ORGANIZATIONAL' MECHANISM FOR CARRYING OUT THE FUNCTIONS, AND MORE IMPORTANTLY, THE ORGANIZATIONS THAT ARE LINKED TOGETHER IN A STRUCTURED MANNER BASED ON WHAT THEY DO AND HOW THEY INTERRELATE WITH ONE ANOTHER. THE ARCHITECTURE MAY ALSO DEPICT VOIDS AND REDUNDANCIES BETWEEN ORGANIZATIONS.

"A WORD OF CAUTION - SOME DEPARTMENTS SUCH AS Q.A. MAY NOT HAVE A PARTICULAR NITCH AS THOSE ILLUSTRATED BUT MAY PORTRAY THE ENTIRE ARCHITECTURE. MORE CAREFUL STUDY MAY BE REQUIRED TO IDENTIFY HOW THEY INTERRELATE WITH THE REST OF MANUFACTURING."

## ORGANIZATIONAL STRUCTURE

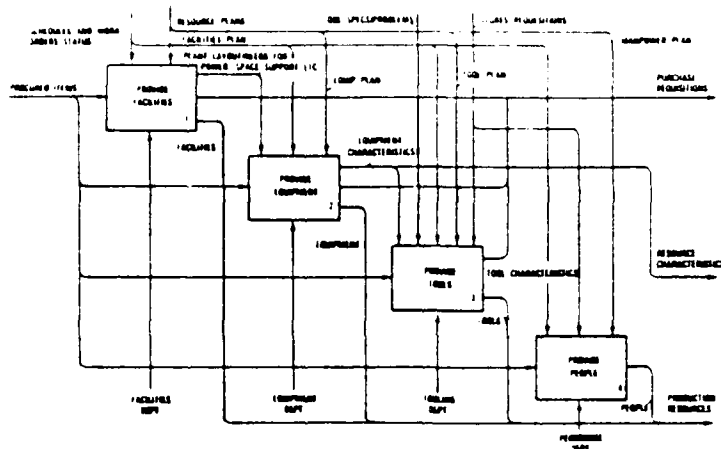


84-4 9

INSTRUCTIONAL OBJECTIVE: To provide an understanding of how architecture can be utilized in planning organizational structure and responsibilities.

NARRATION: "THIS CHART FURTHER DECOMPOSES THE A-4 NODE 'PROVIDE PRODUCTION RESOURCES' TO A LEVEL WHEREIN ORGANIZATIONAL RESPONSIBILITIES CAN BE ANNOTATED AND DEFINED."

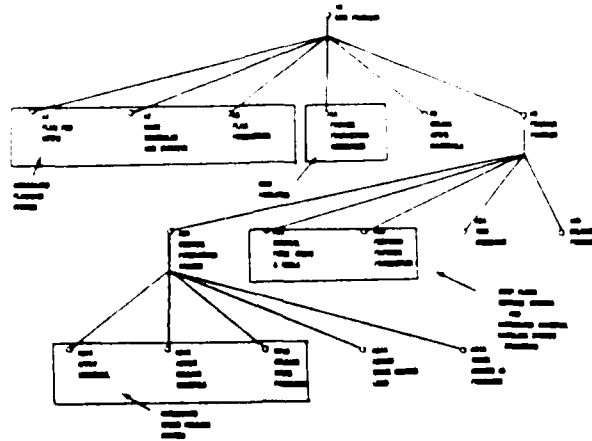
## ORGANIZATIONAL STRUCTURE



50-4 10

INSTRUCTIONAL OBJECTIVE: To provide an understanding of how architecture can be utilized in planning organizational structure and responsibilities.

NARRATION: "THIS IDEF<sub>0</sub> DIAGRAM SHOWS HOW THE ORGANIZATIONAL FUNCTIONS DEPICTED ON THE PRIOR CHART ACT AS MECHANISMS TO ACCOMPLISH THE FUNCTIONS SHOWN ON THE DIAGRAM THAT DEVELOPED THE NODE TREE."



50-1 11

INSTRUCTIONAL OBJECTIVE: To provide an understanding of how architecture is used as a planning vehicle.

REFERENCE: AFWAL-TR-81-4023/INTEGRATED COMPUTER AIDED MANUFACTURING (ICAM) Architecture, Part II, Volume II - Architecture - A Structured Approach to Manufacturing

SEE: (ALL)

NARRATION: "THE FUNCTION ARCHITECTURE NODE TREE CAN ALSO BE USED AS A PLANNING VEHICLE FRAMEWORK FOR DEPICTING THE LOGICAL STEP-BY-STEP, YEAR-BY-YEAR, OR FUNCTION-BY-FUNCTION MODERNIZATION OF EXISTING MANUFACTURING, REORGANIZATION, NEW SYSTEMS OR TECHNOLOGY, NEW FACILITIES, ETC.

THE ARCHITECTURE CAN BE USED TO SUPPORT A CAD/CAM PLAN (FIVE YEAR, TEN YEAR, OR TWENTY YEAR) SHOWING THE IMPLEMENTATION PROGRESSION OF MODERNIZATION. THE IMPORTANCE OF USING THE ARCHITECTURE TO DEPICT THIS ORGANIZATION IS THE ADDITIONAL INFORMATION IT AFFORDS TO THE PLANNING EXERCISE. IT LINKS TOGETHER DISCRETE PROJECTS TECHNICALLY AND IN SEQUENCE OF IMPLEMENTATION.

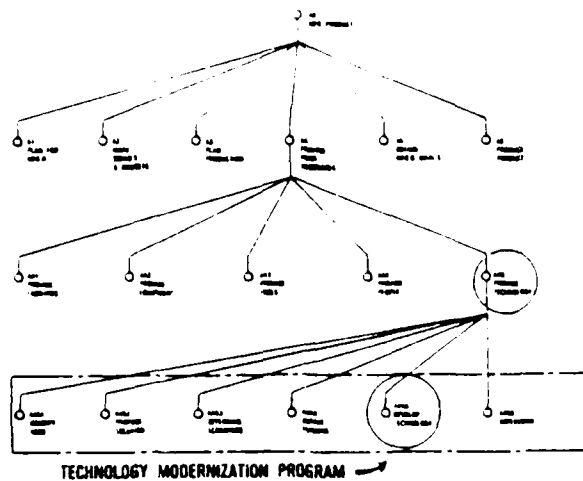
EACH MODERNIZATION PROJECT WILL AFFECT FUNCTIONS IN MANUFACTURING AND, SINCE ALL THE FUNCTIONS ARE RELATED, THE IMPACTS OF THE MODERNIZATION CAN BE ASSESSED FOR ORGANIZATION IMPACTS, SYSTEMS/TECHNOLOGY IMPACTS, ETC.

THERE MAY ALSO BE AN OPTIMUM SEQUENCE FOR IMPLEMENTATION AND THESE ORGANIZATION AND SYSTEMS/TECHNOLOGY IMPACTS MAY EXPOSE THE MOST PRODUCTIVE SEQUENCE. IF NOT, BECAUSE BOTH CAN BE ASSESSED AGAINST THE ARCHITECTURE, THERE IS AT LEAST A BASIS TO EVALUATE OR DEPART FROM TO EVALUATE THE OPTIMUM SEQUENCE."



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## PROGRAM MANAGEMENT



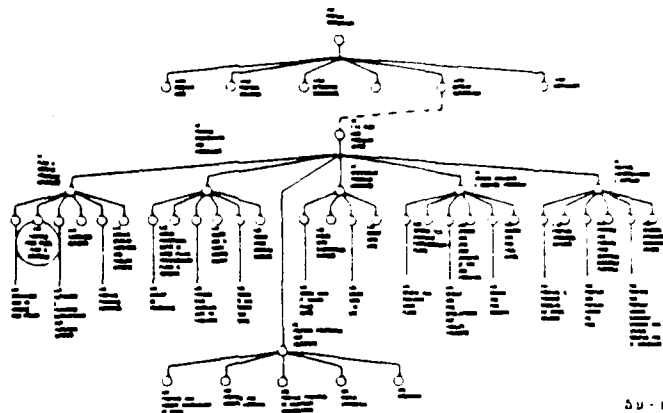
50-1 12

INSTRUCTINAL OBJECTIVE: To provide an understanding of how architecture can be utilized as a program management tool.

NARRATION: "THE FUNCTIONAL NODE TREE REPRESENTATION IS AGAIN SHOWN HERE AS A PROGRAM MANAGEMENT TOOL. IT CAN BE USED TO DEPART FROM MANUFACTURING PER SE TO A PROJECT OR PROGRAM WHICH WILL MODERNIZE OR IMPROVE MANUFACTURING."

## PROGRAM MANAGEMENT

### F-16 TECH MOD PROGRAM OFFICE ACTIVITIES

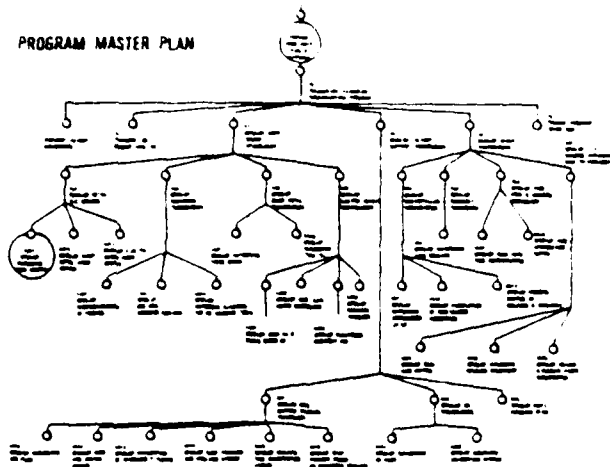


INSTRUCTIONAL OBJECTIVE: To provide an understanding of how architecture can be utilized as a program management tool.

NARRATION: "ACTIVITIES (FUNCTIONS) ARE IDENTIFIED TO CARRY OUT THE PROGRAM."

(WALK THROUGH NODE TREE FOR F16 MANUFACTURING TECHNOLOGY MODERNIZATION PROGRAM OFFICE ACTIVITIES)

## PROGRAM MANAGEMENT

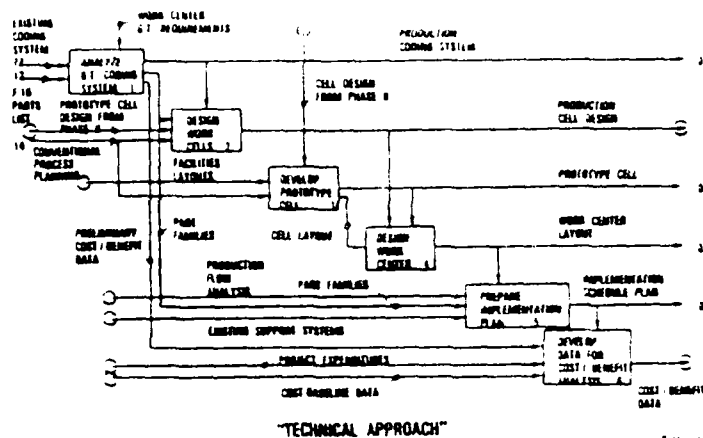


INSTRUCTIONAL OBJECTIVE: To provide an understanding of how architecture can be utilized as a program management tool.

NARRATION: "THE PROGRAM MASTER PLAN/SCHEDULE IS DETAILED WHICH ADDRESSES THE TECHNICAL WORK TO BE PERFORMED AND IDENTIFIES THE PROJECTS WITHIN THE PROGRAM."

(TALK THROUGH NODE TREE GIVING EXAMPLES)

## PROGRAM MANAGEMENT

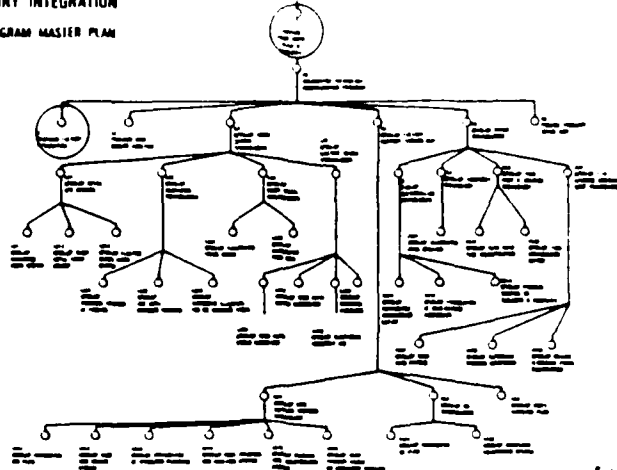


INSTRUCTIONAL OBJECTIVE: To provide an understanding of how architecture can be utilized as a program management tool.

NARRATION: "TECHNICAL APPROACH MODELS ARE DEVELOPED FOR EACH PROJECT TO STRUCTURE THE ACTIVITIES OF EACH PROJECT ENGINEER/MANAGER. THIS ENSURES COMMONALITY AND PROVIDES MANAGEMENT VISIBILITY INTO WHAT THEY ARE DOING AND WHERE THEY ARE WHILE ADMINISTERING THE PROGRAM. THE TECHNICAL APPROACH MODEL IS ALSO A VERY IMPORTANT PROJECT TOOL FOR THE ENGINEER IN THAT IT PROVIDES A BASIS FOR THE ENGINEER TO IDENTIFY AND INVESTIGATE INTERFACES REGARDING DEVELOPMENT THROUGH IMPLEMENTATION AND OPERATION/USE OF HIS PARTICULAR PROJECT END ITEM/SYSTEM."

## PROGRAM MANAGEMENT

FACTORY INTEGRATION  
PROGRAM MASTER PLAN



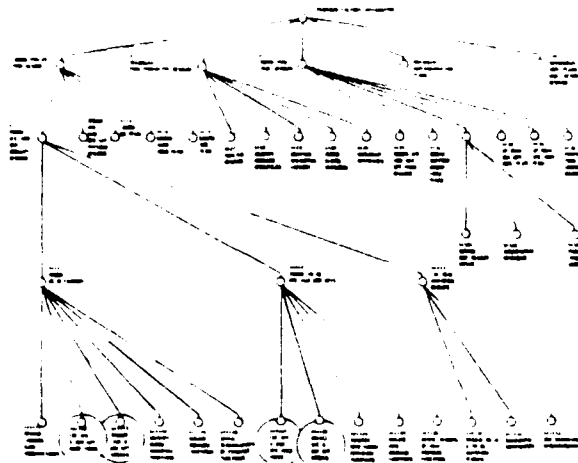
30-1 16

INSTRUCTIONAL OBJECTIVE: To provide an understanding of how architecture can be utilized as a program management tool.

NARRATION: "PROBABLY THE MOST IMPORTANT ACTIVITY IN ANY MODERNIZATION PROGRAM IS 'INTEGRATION' - INTEGRATION, LIKE THE INDIVIDUAL PROJECT END ITEMS, MUST BE PLANNED FOR - BECAUSE IT IS THE SINGLE MOST IMPORTANT PROJECT WITHIN THE PROGRAM."

## PROGRAM MANAGEMENT

### PLAN FOR FACTORY INTEGRATION



50-1 17

INSTRUCTIONAL OBJECTIVE: To provide an understanding of how architecture can be utilized as a program management tool.

NARRATION: "THE PLAN FOR FACTORY INTEGRATION IS, AS STATED PREVIOUSLY, THE SINGLE MOST IMPORTANT PROJECT WITHIN THE PROGRAM. THE SUCCESS OF EACH OF THE PROJECTS, MEASURED IN PRODUCTIVITY IMPROVEMENT, DEPEND UPON IT."

(TALK THROUGH NODE TREE EXAMPLE)

## TECHNICAL TOOL

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- SYSTEM(S) / TECHNOLOGY(S) STRUCTURE AND INTERFACES
- SYSTEM(S) / TECHNOLOGY(S) - ORGANIZATION(S) INTERACTIONS
- SYSTEM(S) / TECHNOLOGY(S) DEVELOPMENT AND INTEGRATION

50-4 18

INSTRUCTIONAL OBJECTIVE: To provide an understanding of how architecture can be utilized as a technical tool.

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NARRATION: "AN ARCHITECTURE PROVIDES TECHNICAL PEOPLE WITH A MEDIUM WHICH TRANSCENDS SYSTEMS AND TECHNOLOGIES AND AFFORDS MANY DIVERSE DISCIPLINES A COMMON BASIS UPON WHICH TO COMMUNICATE A BETTER UNDERSTANDING OF WHO IS DOING WHAT, WHERE, AND TO WHOM.

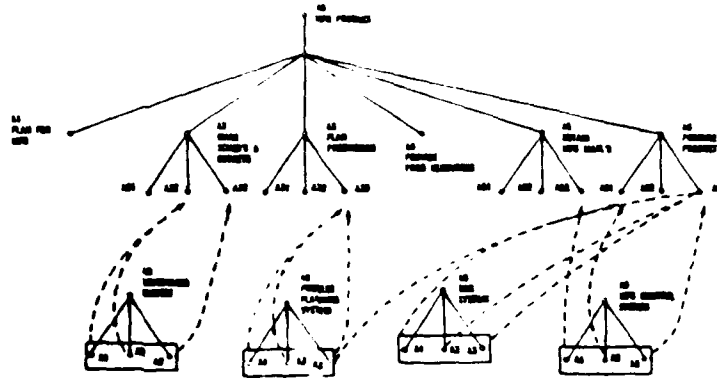
"IT IS A STRUCTURED FRAMEWORK OF THE 'WHAT' (MANUFACTURING) IN TERMS OF FUNCTIONS, INFORMATION, AND DYNAMICS TO BE USED AS A BASIS TO PORTRAY SYSTEMS AND TECHNOLOGIES AND WHERE THEY SUPPORT MANUFACTURING.

"ARCHITECTURE IS A FRAMEWORK FOR IDENTIFYING INTERFACES BETWEEN SYSTEMS AND TECHNOLOGIES OR THE LACK OF THE THEM.

"IT IS A FRAMEWORK FOR ESTABLISHING THE INTERACTION BETWEEN SYSTEMS/TECHNOLOGIES AND THE ORGANIZATIONS THAT USE AND MAINTAIN THEM.

"LAST BUT NOT LEAST, IT IS AN EXCELLENT TOOL TO USE IN CONCEPTUAL INTEGRATION OF NEW SYSTEMS."

## SYSTEM(S) / TECHNOLOGY(S) STRUCTURE AND INTERFACES



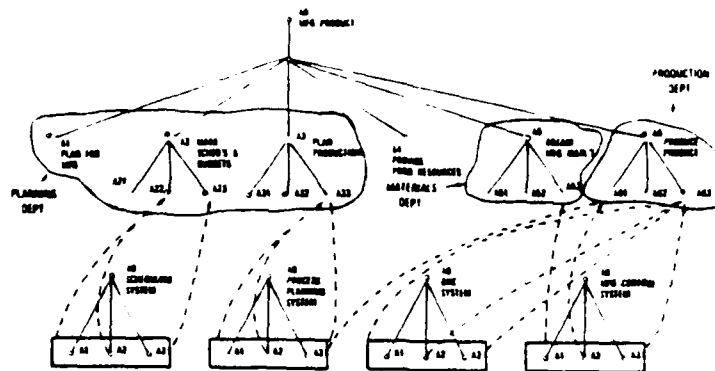
011-4 10

INSTRUCTIONAL OBJECTIVE: To provide an understanding of how an architecture can be utilized as a framework for system/technology structure and interfaces.

NARRATION: "THE FUNCTION ARCHITECTURE NODE TREE CAN BE USED AS A FRAMEWORK FOR SYSTEM/TECHNOLOGY STRUCTURE AND INTERFACES. THE ANNOTATION IS SIMILAR TO THAT FOR THE ORGANIZATIONAL STRUCTURE BUT IT BECOMES MORE NECESSARY TO MODEL EACH SYSTEM PRIOR TO LINKING IT TO THE ARCHITECTURE. AFTER A COMPLETE ANNOTATION OF ALL EXISTING SYSTEMS, THERE IS A NEW PERSPECTIVE FROM WHICH TO VIEW THE FUNCTION ARCHITECTURE - IT NOW DEPICTS THE 'SYSTEM' MECHANISMS FOR CARRYING OUT THE FUNCTIONS. MORE IMPORTANTLY, THE SYSTEMS ARE LINKED TOGETHER IN A STRUCTURED MANNER BASED ON WHAT THEY DO AND HOW THEY INTERRELATE WITH ONE ANOTHER. THE INTERRELATIONSHIPS WILL DEPICT VOIDS AND EXPOSE INTERFACES. THIS PROVIDES A BASIS FOR INVESTIGATING THESE INTERFACES."



## SYSTEM(S) / TECHNOLOGY(S) – ORGANIZATIONS INTERFACES



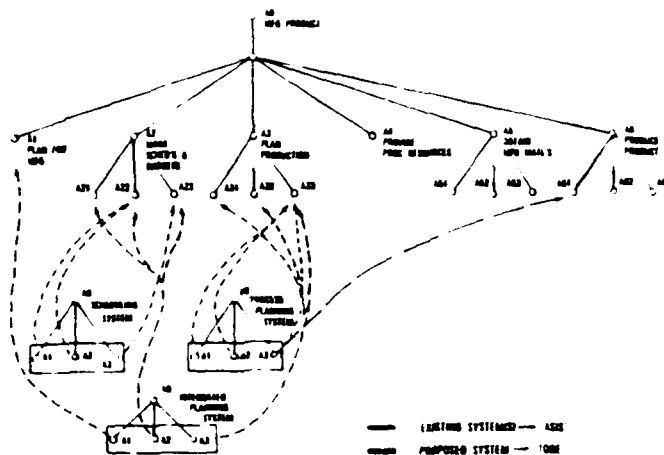
SU-4 20

INSTRUCTIONAL OBJECTIVE: To provide an understanding of how an architecture can be utilized as a framework for system/technology organizational interfaces.

NARRATION: "THE FUNCTION ARCHITECTURE CAN ALSO BE USED AS A FRAMEWORK FOR UNDERSTANDING SYSTEM/TECHNOLOGY ORGANIZATIONAL INTERFACES."

(TALK THROUGH NODE TREE CHART)

## SYSTEM(S) / TECHNOLOGY(S) DEVELOPMENT AND INTEGRATION



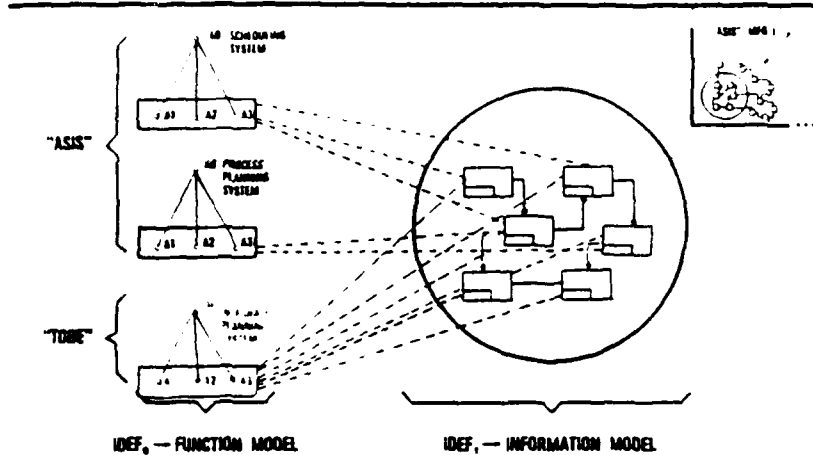
50-1 21

INSTRUCTIONAL OBJECTIVE: To provide an understanding of how an architecture can be utilized as a framework for system/technology development and integration.

NARRATION: "BOTH THE FUNCTION ARCHITECTURE AND INFORMATION ARCHITECTURE CAN BE USED AS A FRAMEWORK FOR SYSTEM/TECHNOLOGY DEVELOPMENT AND INTEGRATION."

(TALK THROUGH SYSTEM VERSUS CHART NODE RELATIONSHIPS)

# SYSTEM(S) / TECHNOLOGY(S) DEVELOPMENT AND INTEGRATION



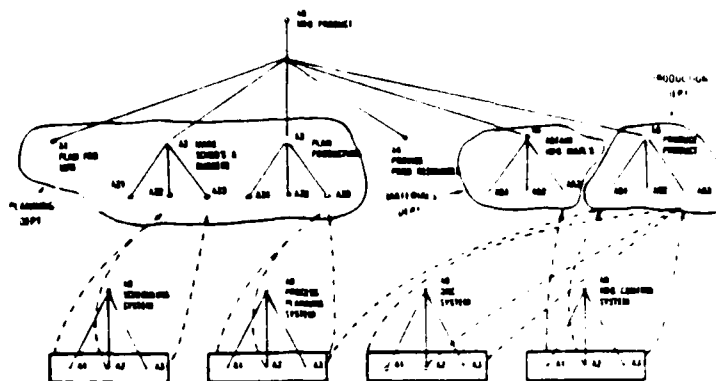
50-4 22

INSTRUCTIONAL OBJECTIVE: To provide an understanding of how an architecture can be utilized as a framework for system/technology development and integration.

NARRATION: "HERE WE SEE THE RELATIONSHIP OF THE 'AS IS' AND 'TO BE' SYSTEM/TECHNOLOGY IDEF<sub>0</sub> FUNCTION MODELS VERSUS THE IDEF<sub>1</sub> INFORMATION MODEL."

(TALK THROUGH CHART IDEF<sub>0</sub> SYSTEM MODELS VERSUS IDEF<sub>1</sub> INFORMATION MODEL)

## EDUCATIONAL TOOL

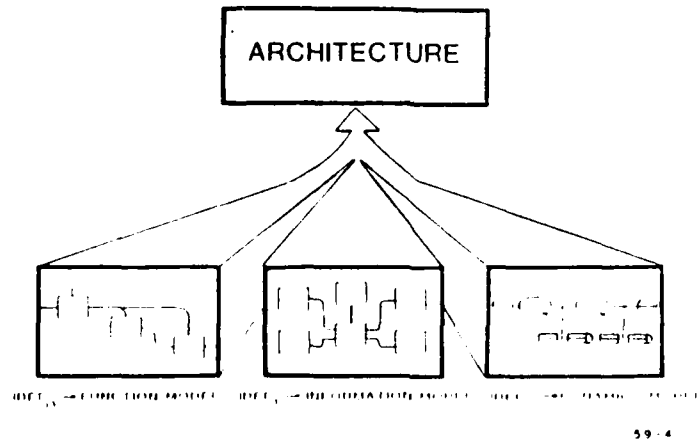


23

INSTRUCTIONAL OBJECTIVE: To provide an understanding of how an architecture can be utilized as an educational tool.

NARRATION: "THE FUNCTION ARCHITECTURE, AS AN EDUCATIONAL TOOL, CAN PROVIDE AN EXCELLENT BASIS FOR UNDERSTANDING WHAT IS BEING PERFORMED, WHO IS RESPONSIBLE FOR ITS PERFORMANCE, AND HOW IT IS PERFORMED. IT CAN ALSO SERVE AS A POINT OF DEPARTURE FOR THE INFORMATION ARCHITECTURE AND DYNAMICS ARCHITECTURE. BECAUSE ARCHITECTURE PROVIDES A STRUCTURED REPRESENTATION OF MANUFACTURING FUNCTIONS, INFORMATION AND DYNAMICS, IT IS EASIER TO COMPREHEND THAN TO PIECEMEAL EXPERIENCE FROM DIFFERENT AREAS OF MANUFACTURING AND INDIVIDUALLY TRY TO TIE IT ALL TOGETHER."

## ARCHITECTURE



INSTRUCTIONAL OBJECTIVE: To provide a summary understanding that all three IDEF modeling methodologies are used to provide all levels of an organization with a common perspective.

NARRATION: "IN SUMMARY, ARCHITECTURE IS A STRUCTURED APPROACH TO MANUFACTURING - A MULTIPURPOSE TOOL. MANY USES HAVE YET TO BE IDENTIFIED. IT IS A COMMON MEANS BY WHICH TO COMMUNICATE A BETTER UNDERSTANDING.

"SOME DAY IT WILL BE TOTALLY DYNAMIC AND THE SHOP FLOOR WILL BE PHYSICALLY TIED TO IT. WHEN WE WANT TO CHANGE MANUFACTURING, WE WILL JUST 'TWEAK A KNOB' ON THE ARCHITECTURE AND THE SHOP FLOOR WILL RECONFIGURE TO ACCOMMODATE. - IN OTHER WORDS, THE PROVERBIAL 'ROSETTA STONE' FOR COMPUTER INTEGRATED MANUFACTURING (CIM)."

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## APPENDIX A TECHNOLOGY TRANSFER TASK SUMMARY

### PROTOTYPE PRESENTATIONS

DACOM conducted the "Practitioner's TECH MOD Workshop" as scheduled in Dayton on 7/8 July 1981. Thirty-six (36) Air Force and contractor personnel were in attendance at this session. Although it was DACOM's first formal workshop presentation, the material was well received. Capt. S. LeClaire agreed early in the session to maintain a marked copy of all of the presentation materials indicating recommended changes to the presentation. Capt. LeClaire provided these comments to DACOM for incorporation immediately following the workshop. Most of the comments were editorial in nature and did not require significant changes in the material.

DACOM has subsequently used the Practitioner's TECH MOD Workshop material in several F-16 Subcontractor Industrial Technology Modernization (ITM) presentations with excellent results. In addition, the initial Executive Overview presentation was simultaneously used at the executive and mid-management level with good success.

DACOM also used the materials prepared under this contract, (augmented by commercial DACOM materials) to conduct a two-day seminar on the ICAM Architecture and IDEFO Function Modeling Methodology on 27/28 April 1982 in London, England. This seminar was sponsored by Computer Integrated Manufacturing - International's (CIM-I) European Office. More than twenty representatives of European industry, academia, and the media attended this session. DACOM coordinated all presentation materials utilized (including DACOM's commercial materials) with the Air Force ICAM Program Office in advance of the seminar. The attached letter was subsequently received from the ICAM Program Office formally documenting Air Force approval of this activity. As indicated in the attached letter, an announcement was also made at the seminar that the Air Force had released AFWAL-TR-81-4023 Volumes IV (Functional Modeling Manual - IDEFO) and VII (Composite Function Model of Manufacture Product - MFGO)

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for unlimited distribution. Data generated on IDFI and IDFI methodology, other than the summary data contained in the overview presentations, remains under government controlled distribution.

The Air Force has requested a formal "Executive Overview Prototype Demonstration" during the upcoming 9/11 June 1982 Project Priority 1104(2) coalition meeting to be held in Dayton, Ohio. DACOM stands ready to support this request as directed by SofTech and the Air Force.

#### RECOMMENDED FUTURE USES

It is recommended that the Air Force consider scheduling a meeting of the ICAM Program Office's Computer-Aided Manufacturing Advisory Group (CAMAG) to conduct an Executive Overview "Prototype Demonstration." These senior level industry executives and technical experts would provide an excellent forum for final review of the material.

It is further recommended that the ICAM Program Office consider establishing an "Executive Day" at each annual ICAM Industry Days Conference. This course of action is recommended in order to communicate the need for Computer Integrated Manufacturing (CIM) to the "executive integrators" as well as the "integratees" that normally attend the ICAM Industry Days sessions. A similar approach is being planned and coordinated by DACOM for the Society of Manufacturing Engineer's Computer and Automated Systems Association's (SME CASA) 1982 AUTOFACT Conference to be held in November 1982 in Philadelphia, Pennsylvania.

It is further recommended that the ICAM Program Office consider a formal Department of Defense (DoD) briefing relative to the availability of these and other ICAM project training materials. Attendees should include the key managers of the Army's Tri-service Electronics Computer-Aided Manufacturing (ECAM) Program, the Navy's Shipbuilding Technology Program (STP), and the various military Technology Modernization (Tech MOD) offices such as the Air Force's Aerospace Industries Modernization (AIM) Program Office and the Army's Industrial Productivity Improvement (IPI) Program Office. This approach would ensure maximum understanding and utilization of the training materials.

It is further recommended that the Manufacturing Technology Transfer Program training materials be made available to technical associations at no cost for use in conducting seminars, clinics, and workshops at attendee cost. (It must be recognized that this approach will undoubtedly bring increased pressure for formal Air Force release of the IDEF1 Information Modeling and IDEF2 Dynamics Modeling methodologies.



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It is further recommended that the ICAM Program Office consider providing this material at no cost to various academic institutions across the country to be used in training students at all levels.

Unless otherwise directed by the Air Force, DACOM intends to fulfill its commitments made in its 18 March 1981 unsolicited proposal. DACOM committed therein to provide these courses to industry upon request with the course cost being born by industry.

#### RECOMMENDED FUTURE COURSE EXPANSION

It is requested that the Air Force authorize DACOM to proceed on the IDEF1 Information Architecture and Modeling Option contained in DACOM's 18 March 1981 unsolicited proposal. DACOM proposes to develop an IDEF1 Information Modeling "Practitioner's Presentation Manual" and a supporting Practitioner's "Train the Trainer's Manual." DACOM stands ready to negotiate this effort upon request.

It is further recommended that the ICAM Program Office consider taking a future similar approach in developing an IDEF2 Dynamics Modeling "Practitioner's Presentation Manual" and "Train the Trainer's Manual."

It is recommended that the ICAM Program Office consider developing training courses and materials to cover the work being accomplished in the 1105 Factory of the Future Conceptual CIM Framework and Implementation Strategy activities and the upcoming 8205 Integrated Decision Support System (IDSS) contract. Perhaps the two-level practitioner/executive overview approach utilized on this 1104(2) Manufacturing Technology Transfer Program would again be a desirable course of action.